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THE Popular Science Review.

A QUARTERLY MISCELLANY OF ENTERTAINING & INSTRUCTIVE ARTICLES ON SCIENTIFIC SUBJECTS.

EDITED BY JAMES SAMUELSON.

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No notice can be taken of anonymous contributions. Intending contributors are respectfully requested to send their names and addresses; and, if accompanied with stamps, unsuitable manuscripts will always be carefully returned.

All communications to the Editor are to be addressed to 192, Piccadilly.

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TO CORRESPONDENTS AND CONTRIBUTORS.

The present Editor's connection with the POPULAR SCIENCE REVIEW ceases with the publication of this number; and, unless otherwise announced, all communications intended for the Editor must be addressed to the Publisher. In taking leave of his numerous correspondents, the Editor tenders to them his sincere thanks for the consideration they have always extended to him, and his earnest wishes for their prosperity.

The POPULAR SCIENCE REVIEW will in future be edited by HENRY LAWSON, M.D., Professor of Physiology, Queen's College, Birmingham, author of "Popular Physiology," &c.

In coming to the conclusion of the second volume, the publisher of the POPULAR SCIENCE REVIEW begs to thank that large class of the public who have given their support to the undertaking.

When the work was commenced in October, 1861, many people thought there was but a very limited field for such an undertaking, others, amongst whom were the editor and publisher, thought there was a very large field, and the result has proved the correctness of their views. When it is borne in mind that in this country there are societies formed for the furtherance of every branch of knowledge, each of these societies having its periodical and holding its meetings for the exact treatment of each subject in all its minute details, it does not appear surprising that a large class could be found who wished to know what was going on, although they had not taken up any branch of science as students in the strict sense of the word. The discussions at the various societies, and the articles in the special periodicals, were necessarily of such a technical character that it was impossible to obtain the information they desired. To fill up this want the POPULAR SCIENCE REVIEW was started.

Before commencing the ninth number and third volume, it is deemed advisable to give the subscribers a sketch of future operations. As in previous numbers, the Magazine will open with five or six original articles by writers of well-known ability and standing. These articles will be as much as possible varied, so that no one branch of science will be represented to the exclusion of the rest. Whilst as much as possible will be done to consult the tastes of the public at large, there will be articles acceptable to those who are interested in particular branches, such as Astronomy, Botany, Chemistry, or Microscopy, as well as articles having for their subject the appliances of Science to Art, Manufacture, Agriculture, and every-day life.

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THE ANTIQUITY OF MAN.

BY J. R. LEIFCHILD, M.A.

HOW long has man been a tenant of this earth which he is now so rapidly subduing and so extensively populating? What was the probable geological epoch in the shadowy past when he first made his appearance here, as the last of a grand series of animals created to succeed each other in ordained and typical sequence? This question has recently been rendered universally interesting by the book of Sir Charles Lyell, although it had been agitated amongst geologists for some years. While the common opinion has always been that man first inhabited our globe about four thousand years before Christ, or nearly six thousand years ago, a few far-sighted observers saw reason for arriving at a very different conclusion; and Dr. Schmerling, M. Boucher de Perthes, Dr. Falconer, and Mr. Prestwich, have during recent years severally investigated the geological evidences of man's great antiquity in different localities until each and all of them have admitted and advocated it.

A succinct and popular notice of the evidences for such human antiquity may be acceptable to our readers, divested of technicalities and condensed within moderate limits.

The evidences derived from the actual presence of human bones, but more commonly of works of human art in caves, first claim our attention; and of these the discoveries of Dr. Schmerling were both earliest in time and most decisive in character. In caverns in the limestone which rises up along the banks of the Meuse, this persevering geologist disinterred unquestionable human bones from two or three localities, and a now celebrated skull from the Engis cave. Much discussion has been held over and about this skull, as respects the race of men to which it belonged. The most recent and the clearest observations upon it have been made by Professor Huxley, from which we may present the following paragraph:—

> I can find no character in the remains of that cranium which, if it were a recent skull, would give any trustworthy clue as to the race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls which I have examined, and especially has it a ten-

dency to that occipital flattening to the great extent of which in some Australian skulls I have alluded. But all Australian skulls do not present this flattening, and the supraciliary ridge of the Engis skull is quite unlike that of the typical Australian. On the other hand, its measurements agree equally well with those of some European skulls, and assuredly there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher, or might have contained the brains of a thoughtless savage.

Another human skull was discovered, in 1857, in the Neanderthal valley, near Düsseldorf, in Germany, and it is probable that the whole skeleton was originally preserved, although destroyed by the workmen, excepting some fragments of the larger bones. This is the most ape-like in its shape of any known human skull. Its capacity, however, is estimated as equal to seventy-five cubic inches, which is about the average capacity of present Hottentot and Polynesian skulls. In no sense, then, except mere shape, is the Neanderthal skull ape-like, and in no sense can it, with the accompanying bones, be considered as having belonged to a race of men intermediate between human beings and the apes. Though lower in type than the Engis skull, the Neanderthal man was, in all probability, nearly of average European size and stature.

These human remains are thought to be amongst the oldest at present known; and Dr. Schmerling, about thirty years ago, expressed his belief that they belonged to men who were contemporary with the quadrupeds of extinct species whose remains were found with them. This view was totally dissented from by Dr. Buckland, although he had nearly convincing evidence of its truth under his own eye when he was an explorer of the cave of Paviland, on the coast of Glamorganshire. There he saw a human skeleton, and the remains of recent testacea of eatable species which may have been carried in by the man himself when alive. There also were found numerous bones of animals, the entire mass of which appear to have been disturbed by ancient diggings, so that the remains of extinct animals had become mixed with recent bones and shells.

The instances in which works of human art have been discovered in caves are more numerous than those in which human bones have occurred. In England, we specially notice the "Wokey Hole hyæna den," in Cheddar cliffs, near Wells, Somersetshire, which but for a fortunate incident might have remained unknown for centuries longer. It had been filled up to the roof with *débris*, stones, and organic remains, and no one had suspected its existence as a cave until by chance attention was directed to it. It was then

found to be a rich repository of curious remains. In three areas of this cave were found ashes of bone, and especially of the extinct woolly species of rhinoceros, associated with flint or chert implements of the same type as those found near Amiens and Abbeville, though they were ruder, and therefore, in all probability, of earlier date. They were found near *underlying* layers of peroxide of manganese and comminuted bone; and also *overlying* remains of the hyæna, which mark the old floors of the cave in one of its areas.

From the phenomena and facts observed in this cave, Mr. W. B. Dawkins, who examined it, inferred that man, in one of the early, if not in the earliest, stage of his existence, dwelt in this cave, as some of the most degraded of our race do at the present day in some countries; and that he manufactured his implements and weapons out of flint brought from the chalk downs of Wilts, from the least fragile chert of the greensand strata at Blackdown Hills, in Devonshire, and also arrow-heads out of the more easily worked bones of animals of that era. Although the men of this cave employed fire, and were acquainted with the use of the bow, yet with their puny weapons of flint and bone they were far worse armed than the wild beasts of that day with their sharp claws and strong teeth. But the very fact that man held his ground against them, shows that cunning and craft more than compensated for the defects in his defensive arms. Again, as he was preceded in his occupation of this cave by some kind of wild beast, as was proved by the underlying fragments of bone; so he was succeeded by another kind of beast, the hyæna, as proved by the overlying bones.

How favourite a resort of quadrupeds this cave must have been, is manifest from the quantity of animal remains extracted from it. In all, these consisted of one thousand bones, one thousand and fifteen teeth, and one hundred and fifty-six jaws belonging to the lion, wolf, fox, bear (of two species), badger, the cave-hyæna, ox, deer (six species), Irish elk, horse, and rhinoceros (of two species). Amidst this aggregate of diverse quadrupeds did man find his entrance, and fix his crude habitation. What was man then?—the lordly biped; but at that time how lowly, how mean, degraded, and animalized, how unlike the civilized, reading, reflecting man of to-day!

Of other caves the principal ones may be briefly alluded to. The Gower caves, in South Wales, yielded to Dr. Falconer human bones amongst those of the elephant, as the Paviland cave did to Dr. Buckland, and as the Spritsail Tor and the Mewslade fissure did to Colonel Wood, in addition to abundant flint knives and bone weapons, all evidently shaped by man. A very significant exploration was conducted by Dr.

Falconer and Mr. Everest, in the spring of 1858, in a cave at Brixham, Devon. All possible precautions for a faithful registration of discoveries were adopted, and it was soon announced that human industrial works had been discovered, mixed indiscriminately with bones of the rhinoceros, hyæna, and other extinct animals, in the undisturbed ochreous gravel and earth of the cave. Experienced geologists examined the cave and its whole products, and concluded without doubt that they had not been introduced by different natural agencies at wide intervals of time. The establishment of this fact is obviously of great importance in similar researches, for upon it nearly the entire value of cave evidences for human antiquity rests.

The Brixham cave may be regarded as in itself a complete geological case in point, since no preventible chance of inaccuracy was left unprovided for, and every fact was corroborated by careful examination. It is true that no human bones were discovered in it, yet many humanly-worked flint knives were found, chiefly in the lowest part of the bone earth, and a very perfect one was disinterred at a depth of thirteen feet from the surface, covered with bone-earth of the same thickness. Fifteen other flint knives were extracted in another part, which was at the same level as, though not in connection with, remains of mammalia. In the bone-earth also of this level an entire left hind-leg of a cave-bear was exhumed, with every bone in its natural place. It must, therefore, have been introduced to the cave when clothed with flesh, or, at least, while the separate bones were bound together by their natural ligaments, and buried in that state in the mud. Other interesting facts of a like character were noticed in the Brixham cave.

Dr. Falconer's researches in richly ossiferous caves in Sicily produced similar results, and it may be fully expected that other ossiferous caverns will, from time to time, add to the geological evidences of man's contemporaneity with several extinct mammalia. Even while we write we learn that another ossiferous cavern of interest has just been discovered in the rock of Gibraltar. There a human skull was found embedded in bone-earth, in close contiguity with a stone implement; and the bone of a large mammal twenty feet below the surface of a limestone plateau of very compact and solid rock. Seventeen feet below the level two human jaws were found, and close by it two stone knives, together with an oblong slab of sandstone, having one surface much worn and polished as if by friction. Many other interesting relics of human presence have been dug out from the same cavern, with fragments of pottery and bits of charcoal; all, however, tending to show that the men who once harboured in it were not of the most ancient races.

The preceding abstract of the most striking cave evidence has led eminent geologists to conclude, apparently with much reason, that man was contemporary with the mammoth, the cave-bear, the hyæna of dens, and several other extinct mammalia. To avoid this inference upon geological grounds is certainly not easy, nor can we fairly expect stronger evidences than the above, for these are both individually satisfactory to competent geologists and also cumulative. Other geological conclusions are admitted as established upon similar evidence.

So much has been said and published upon the famous flint implements of Picardy that it is unnecessary here to repeat details of their position and characteristics. The most cautious readers must be prepared to admit that equally cautious observers have at least very fair grounds for believing these flint weapons to be genuine as to antiquity, and unquestionably indicative of human handiwork. We ourselves have examined many of them, at home and abroad, and it would be sheer obstinacy to deny that they have been shaped by men. There are several minute characteristics by which genuine antiques can be distinguished from modern impositions; and no well-versed examiner can entertain doubts of the human markings in at least some hundreds of chipped flints extracted from the fluviatile gravels near Amiens and Abbeville. Dr. Falconer has recently shown to the writer two of the finest and most unquestionably worked flints from near Abbeville, which would carry conviction to the mind of any unprejudiced observer.

That a human jaw has been lately found, in association with shaped flints, in the gravel-pits at Moulin-Quignon, near Abbeville, must be known to nearly all readers, as well as the fact that it has been the subject of much discussion and minute examination with respect to its genuineness and antiquity. A joint French and English commission of naturalists and geologists carefully and locally investigated the whole matter. *Haches* (or flint hatchets) were disengaged from the cliff of the gravel-pit at Moulin-Quignon in the sight of these gentlemen, and they were convinced of the actual occurrence of the jaw in the "blackband;" but there was not the same unanimity about the age of the jaw itself. Dr. Falconer thought "the finding of the jaw authentic; but that the characters which it presents, taken in connection with the conditions under which it lay, are not consistent with the said jaw being of very great antiquity;" and Mr. Busk adds that "there is no longer reason to doubt that the jaw was found in the situation and under the conditions reported by Mr. Boucher de Perthes; nevertheless it appears (to Mr. Busk) that the internal condition of the bone is wholly irreconcilable with an antiquity equal to that assigned to the deposits

in which it was found." Here, of course, Mr. Busk refers to the prevalent geological opinion that the gravels of Moulin-Quignon belong to the "high level" gravels of Mr. Prestwich, which are regarded as the oldest beds on the banks of the river Somme.

In the above condensation we have referred almost exclusively to what are at present the presumed oldest remains of man and his handiwork. Our limits forbid the introduction, at least in this article, of explanations of less remote evidences of human antiquity; and if we have proved the greater, we have inclusively proved the less. To those who desire a definite computation of something approaching to the number of centuries to which the remains cited point, we can only say that no such definite computation can be made, and geologists seem averse to commit themselves to any conjecture of actual time on this point. When Sir Charles Lyell states that if the Natchez man's remains are genuinely antique, they indicate an antiquity of at least one hundred thousand years for the first population of the valley of the Mississippi, he leaves the range of estimate for other relics open to any latitude or longitude which other geologists may choose to calculate. Yet it is manifest that, if the opinions of those who demand for man the longest antiquity be well founded, more than one hundred, or perhaps two hundred thousand years will be requisite, according to the Lyellian method of estimating geological time.

The public at large, and especially certain classes of persons to whom geological science is new and strange, naturally shrink from such conclusions. The question, however, must inevitably be tried upon its own appropriate evidences, and if these are adequate to conviction then preconceived chronology must give way. On the one hand we may not regard the comparatively immense antiquity of man as absolutely demonstrated; but on the other hand we must not ridicule and cast aspersions upon the opinions of men of high geological eminence, whose interest in the matter is not personal but simply scientific, and who have for some years devoted their best powers to the elucidation of the topic. With these gentlemen we are disposed to think that time will add considerably to the evidences for human antiquity, and we should not be at all surprised if within a few years it becomes generally admitted as a geological canon.

At the same time there are geologists who are not yet prepared to side with the antique party. Pre-eminent amongst these is that very practical French geologist M. Elie de Beaumont, who during the discussion on the Abbeville jaw, delivered his opinion that the gravel deposit of Moulin-Quignon does

not belong to the Quaternary or Diluvian age at all, but to the *terrains meubles* of the actual or modern period, in which he would not be in the least surprised if human bones were found. For himself, however, he added that he did not believe in man's contemporaneity with the extinct elephants, rhinoceroses, and other mammalia of the Quaternary period. Neither also did Sir Charles Lyell at one time; but he and others have gradually become advocates of great human antiquity.

On the whole, the difficulties of disbelief appear to us to be greater than those of belief; and even if the amount of antiquity be reduced, so that from one geological epoch we are compelled to retreat into another and less remote, nevertheless even with the strictest circumscription and the sternest concision, we can scarcely be brought back to a duration of man at all corresponding with the popular chronology. Suppose, for example, that the age of the Picardy gravels overlying the shaped flints should be subsequently estimated at far less than their now presumed age, even then twenty thousand years or more would be, as geologists reckon, but an inadequate period for the accumulation of from sixteen to twenty feet of material in the common course of geological deposition.

If, however, we once transcend so greatly the popular chronology as to attribute to man an antiquity of even twenty or thirty thousand years, the Rubicon is passed, and may we not as well march boldly on from the other side, without remembering what the passage of the river cost us, or how long we hesitated upon its bank before we ventured to bathe our feet in the chilling waters?

NOTE.—At a meeting of the Geological Society on June 3rd, an interesting and animated discussion followed the reading of a paper drawn up by Mr. Prestwich on the Gravels of the Somme, in Picardy. Dr. Falconer explained the difficulty he had felt respecting the alleged human jaw from Moulin-Quignon, and rather recanted his published assent to the "authenticity of its finding." He was succeeded by Mr. Evans, who detailed the suspicious circumstances of the flint implements said to be found near it, and confirmed the doubts of Dr. Falconer both as to the flints and the jaw. Mr. Busk spoke respecting the jaw, and his minute examination of it. On the whole, there appeared much reason to conclude that the jaw was far more modern than the gravel, and that it may have been the jaw of a man of the historic period, perhaps of the Romano-Gallic times. The almost inevitable inference from the evidence stated by the above-named three gentlemen was, that the jaw was not a remnant of a primeval man, but of a man who lived in historic times.

ON THE PHYSICAL GEOGRAPHY OF THE IONIAN ISLANDS.

BY PROFESSOR D. T. ANSTED, M.A., F.R.S.

PART I.

THE group of islands adjacent and nearly parallel to the shores of Albania and Greece that are known as the Ionian islands, may be regarded as the summits of a nearly submerged mountain chain, parallel to the Pindus, and having a similar geological axis. The islands may well be regarded as a group, for they all exhibit nearly the same class of phenomena, and nearly in the same way. The principal rock is everywhere a peculiar limestone, very easily acted on by the weather. This limestone is seen partly in its normal state as a rock *in situ*, but more frequently broken into innumerable fragments. It is also presented as a conglomerate, or recomposed rock, made up of fragments, either angular or rolled by water, cemented by carbonate of lime, and mixed with many flints. With the limestones are marls locally abundant, and some marly sands, while gypsum occasionally takes the place of carbonate of lime. The islands afford a great variety of scenery, and are a perfect study to the artist, the geologist, and the physical geographer of all that is most interesting in lime rock. There are caverns in abundance, rocky cliffs, peculiar kettle-shaped valleys, mountain chains, ridges, plateaux, and rocky ravines. The alternations of softer rock and marl, though few and local, are not without importance as contrasting with the limestone.

Geologically, the axis consists of the Scaglia, or Apennine limestone, often loaded with flints, and nearly of the age of our chalk. It is sometimes made up of those peculiar fossils the Rudistæ, of which the Hippurite is a familiar genus. This is flanked by a great thickness of tertiary limestone, partly of the olden period, and containing fishes like those of Monte Bolca; partly more modern, and in many places consisting of a very modern conglomerate formed under water, but now lifted at a steep angle, parts of it being more than two thousand feet above the level of the Mediterranean. There is, besides this, a much newer sub-aerial conglomerate now forming, but already of great thickness in certain localities.

Although the islands are very similar in the details of their physical geography, it will not be possible to make the matter intelligible without referring to each separately. I will, however, avoid repetition as much as possible, and point out the most essential peculiarities in the island in which each seemed to me most striking. Thus, the peculiar kettle-shaped valleys are highly characteristic of Corfu, although in Santa Maura there are some of great interest. So the ridge-like character of the Scaglia is best seen in Cephalonia, where also exists the loftiest mountain-chain, and where the weathering struck me most forcibly. Santa Maura exhibits the phenomena of the conglomerate. Zante, the valleys, and some of the mineral contents of the rocks, especially the mineral pitch. Ithaca, the island of greatest classical interest, and one that is highly picturesque, is but one continuous ridge, secondary to Cephalonia. Cerigo is the island of caverns. Paxo and the smaller islands I shall hardly have space to allude to in this brief sketch.

Corfu is politically the most important of the islands, though not the largest or most peopled, Cephalonia exceeding it in both these respects. This political importance is derived partly from its position at the mouth of the Adriatic, partly from its harbour, and the sheltered channel between it and Albania, but chiefly from the fact that the town and harbour are defensible, a matter that can hardly be said of any other island in the group. Corfu is also the island first reached from the north.

Corfu is a long strip of land with a transverse mountain-chain. It is shaped like the capital letter **T**. The outline of the island is formed by high land along the western side, and also across the northern end, forming the top of the **T**. The eastern side is divided into two principal tracts of low ground by a picturesque chain that crosses it a few miles south of the town, and culminates in the mountain called Santi Deca, or the Ten Saints. The west coast of Corfu is fine, bold, and highly picturesque. Within the line of the hills and cliffs is the cultivable land, broken and very beautiful, and covered almost entirely with olive-trees, only varied occasionally by the tall black cypress which is very abundant in certain localities. The olive in Corfu and most of the islands being allowed to pursue its natural growth after a very early grafting, is a wonderfully more picturesque, though perhaps not so profitable a tree as when cultivated and kept down in Italy and Provence.

The mountain system of Corfu in the north stretches quite across the island, and rises into two principal peaks, the higher of which, San Salvador, is about 3,500 feet above the sea. Between these two is a tract of broken, but elevated table-

land, and the ridge continues to the sea on both sides. It is on the south side of this chain that the enclosed valleys are seen that are so characteristic of the islands.

There is a very beautiful ride or drive from Corfu across the island to Pelleka, a cliff overlooking towards the west a lovely broken piece of wooded but little cultivated ground, not unlike some part of the Undercliff of the Isle of Wight. Looking east, the rich plains of Corfu are seen dotted here and there with small villages. To the north, however, the view is very different. Coming to the very edge of an inland cliff, one sees with astonishment a tract immediately below extending at a perfectly dead level for some miles, shut in towards the north by the mountain range of San Salvador, which rises with singular abruptness; shut in also on each side by other lower hills, but equally abrupt. Towards the west the hills are very narrow, merely serving to separate the valley from the sea. This remarkable valley is called the Val di Roppa. Entirely without natural drainage, it is the receptacle of a large quantity of rain falling on the mountain sides adjacent. All this rain runs down into the valley, carrying with it abundant stones and mud from the hill sides. These gradually accumulate, and have formed the flat bottom. The rain, retained for some months on this bottom, poisons the air of the whole neighbourhood, but is generally evaporated off in time to allow of crops being sown. During winter it is first a lake, and then a swamp, and is a favourite place for shooting waterfowl. During spring it is cultivated. During summer it is the source of malaria, and helps, no doubt, to render the air of Corfu so insalubrious, that the population for many years past has been almost stationary, and the miserable villages surrounding the valley are kept constantly at the lowest point; the men and women dying young, and the children being seldom reared.

This valley is only one of several. Immediately adjacent is another of the same kind. Not far off is another perfectly round, where the water remains so long on the ground that there is no cultivation. South of Santi Deca, in the other part of the island, there is one known as the lake of Corissia, shut in in a nearly similar manner, and almost as large as the Val di Roppa. In Santa Maura I have seen them exactly resembling a vast artificial amphitheatre. In Cephalonia they are deep lakes. Wherever they are seen they are of a similar nature. They are great hollows with limestone bottoms, surrounded by limestone rocks. From the rate at which the water disappears through the bottom, it is certain that they have communication with some natural drainage, only checked by the deposit forming at the surface by what the rain brings

down from the hills. They are in fact valleys produced by the sinking in of the strata into some great natural cavern formed or enlarged by the infiltration of the rain-water. They vary much in size, but none are too large to be thus explained.

As might be expected, caverns abound in districts so calcareous, and many of them have been described. They offer nothing remarkable, except indeed that in the island of Cerigo, which does not belong naturally to the Ionian group, the limestone fragments have formed a breccia with bones of extinct animals; but all of them illustrate the state of the rock. There is, however, a still more curious illustration of this in Cephalonia, close to the town of Argostoli. A large and broad gulf enters from the south to the western part of Cephalonia, and from this a small transverse bay opens to the east. A spit of comparatively low ground with hills behind marks the junction of these two bays. Part of the land here appears to have sunk in, and the naked limestone rock, much broken, forms a kind of reef, keeping the sea from the narrow low tract of sunken ground. At three or four places the reef is broken, and the sea enters narrow irregular fractures, and is swallowed up in the earth. Advantage has been taken of this curious inversion of the usual order of things, and two mills are worked by the power of the entering stream of salt water made to turn an undershot wheel. The mills worked by the rush of sea-water losing itself in the earth have long been a subject of great astonishment both to the inhabitants and to the few strangers who visit Argostoli. Certainly, that there should thus be a permanent rush of water into cavities in the rocks close to the sea, and considerably below the sea-level, and that this should go on permanently, or for an indefinite period, without filling the cavern, is an extraordinary phenomenon, and requires explanation. No doubt, the generally broken and cavernous state of the limestone, in all directions, suggests a clue to the mystery; but the full explanation is to be found in the climate, which is such that, during a great part of the year, the surface is always burnt up, so that the evaporation must exceed the natural supply from rain if any means exists of supplying the deficiency. The rock being split, and full of capillary fissures as well as more open cracks, there will always be evaporation from the pools or moist rock at whatever depth, so long as the surface is dry and heated. Thus, the water entering the broken rock finds its level in some subterranean caverns where the surface always remains below that of the sea, because more water is carried off by evaporation than is received from the sea and the rains together. The perfect dryness of the surface, combined with the presence of malaria in the Val di Roppa, and many others

of the kettle-shaped valleys, are further illustrations of the work of nature in this respect.

The weathering of the limestones in the Ionian Islands affords some of the most interesting and remarkable examples of sub-aërial action that can anywhere be seen. It is worth travelling to Greece to see what can be done in this way. From time immemorial Greece and the Greek islands have been remarkable for their troublesome barking dogs, and also for the means nature provides for ridding oneself of the annoyance. Homer tells us that when poor Ulysses, disguised by Minerva, visited his old swineherd Eumæus at the Rock of Corax, in Ithaca, he landed, and had no sooner approached the enclosure than he was attacked by his own dogs. So accustomed, however, are the dogs to be driven off by throwing at them the innumerable loose stones ever at hand, that one has only to stoop to ensure their running away. The history of these stones is not a little interesting, for they are the examples, proofs, and indications of destruction caused by the air and the weather.

The loose stones are so predominant that it is not often one has an opportunity of seeing the actual solid rock beneath; and in a majority of cases, when compact rock is seen, it is a reconstructed mass or breccia of stones, either rounded or angular, which for some local reason has formed a capping and checked the atmospheric action. It is interesting to trace the history of destruction. Selecting a particular stone of large size, we shall find it pierced by numerous holes of various depth. Some run quite through, a passage having been bored whose size varies from an inch to a foot in diameter. In these the boring implement is no longer visible. Others are bored to a depth of a few inches, a foot, or even a yard. In the smaller bores are single plants, small or large, according to circumstances; in the larger ones, a complete garden and a quantity of vegetable soil. I have seen at least a dozen kinds of wild plants at the bottom of one wide and deep hole. Nor are these holes all vertically downward. They slope at considerable angles. Some of them are so placed that they can hardly allow the rain to enter. Some are irregular; some are imperfect; but the connection of vegetation with the holes bored in the stone is quite unmistakeable. I have often seen and studied weathering in rocks of various degrees of hardness, but I know of no such examples of rapid and complete weathering. Riddled by these holes, which cross each other in various directions, the large detached rocks are rapidly converted into smaller ones, and these again into mere stones. Ultimately, no doubt, the stones are rolled and ground down to powder and sand, or are carried into the valleys; but as fast

as one broken surface is cleared off another is ready, preserving the same general appearance, though with materials constantly changing.

It was an interesting point to discover, if possible, the time required for this destruction in any particular case, and though not easy in a single observation, there are means at hand in these islands which help greatly an estimate. Such are the ancient walls of cities celebrated in history, but of which absolutely nothing now remains but vast blocks of stone piled in regular order, and originally serving as a defence against the most approved mode of attack in their day. The latest period of the most complete work of this kind is more than two thousand years ago. No doubt at that time the walls of the ancient Samos in Cephalonia, attacked by the Romans and resisting for four months the most strenuous attacks of M. Fulvius, were in good condition; and therefore, in looking at their present state, we see the work of twenty centuries, or thereabouts, of weathering. Of the buildings enclosed within the walls, some may have been built, and all, no doubt, were covered in with tiles; for the whole soil is so mixed up with fragments of burnt clay, that the stones, however abundant, are hardly noticed. The ground is literally covered with pale red fragments of burnt clay, and as brick is less liable to injury than limestone from weathering, there is good reason for this. But although a place where stone is so infinitely abundant, and in a country whose inhabitants were certainly familiar enough with the mode of working it, so that there was every possible reason for stone having been used for all kinds of constructive purposes, hardly one fragment of stone-work has been discovered either on the surface or buried, except the walls themselves. And there is but one explanation—everything else has been worn to powder by weathering. In the ruins below, where the Romans established themselves and remained for a long time, it is curious to see how well their work has been kept when consisting of bricks and mortar, or even terra-cotta of the commonest kind; but there also, except a fragment or two of statuary sheltered amongst the ruins, there are no worked stones.

The reason why the walls still remain, in spite of the absolute annihilation of every other sculptured stone, one has not far to seek. The whole design and construction of these walls is on a scale so gigantic as to have fairly resisted the efforts of decay in many parts, while in others it has partially yielded; and it is this partial destruction which renders the whole in some measure a scale by which to estimate the rate of decay. The walls are of the kind called Cyclopean—composed of hewn stones of size so gigantic that no one in modern times has

given a satisfactory account of the mechanical means by which they could have been lifted into their places. Like those curious Druidical monuments in Western Europe and on our own island, they contain a mystery. The construction shows three stages of rough art. The earliest involves only the selection of large blocks, whose surface was dressed, but of which the natural shape was not altered. Marvellous ingenuity was shown in so selecting and placing these stones that the salient angles of one should fit the retiring angles of others, so that a solid and compact wall should be formed without mortar. The blocks of this work vary from one to five tons in weight. The second stage involved the use of larger stones cut to regular shapes, but not with right angles. The stones are polygons, perfectly worked and accurately fitted. Some of the larger stones must weigh ten tons, and there are few smaller than two tons, even to fill up gaps. Lastly, the stones are found regularly squared, like those still used, but of dimensions utterly beyond comparison. Single stones, sixteen feet long, four or five feet high, and three or four wide, are not unknown. Large stones have been raised to a height of ten or twelve feet; and the walls themselves that surrounded the town of Samos in Cephalonia, when it was attacked by the Romans, were not less than twenty-five feet in height. It is clear that the oldest work had failed from time to time, and had been replaced here and there by new work in the style of the day; and thus the same wall will contain portions of each style down to the Roman occupation. It is certain that from the time of the Romans to the present day there have not been inhabitants in the Ionian Islands to perform the utterly useless task of removing these heavy stones for any useful or mischievous purpose. No town or even village has been built near, except a few houses in the present century. Any injury the walls have suffered must be by the hand of time. When, therefore, we see them partially standing, partly fallen—when we find the ground on each side of the walls blocked up with fragments, shapeless and weather-worn, with trunks of trees grown into and enlarging the intervals between two stones, and thus dislodging the upper ones—we may be sure that nature alone has operated. The result is that of the whole length of a great wall, originally not less than twelve feet wide and upwards of twenty feet high, there now remain only the lower stones. These are much interrupted by large gaps; the stones that are still in their place are almost without exception pierced through and through with large holes, in which, when incomplete, plants will invariably be found. The stones most recently overthrown are now being broken up into small fragments by similar action, and in many cases the very rock itself

on which the stones were placed, as on a firm foundation, is lower by several feet at a little distance from the walls, these having sheltered the foundations while the work went on rapidly on the stones above. It is only in a few places that the height of the ancient wall is indicated. Not in a single instance did I see a good specimen either of Cyclopean, polygonal, or the more finished Hellenic work detached from the wall by accident and at all recognizable. On the other hand, where, as in Santa Maura, the walls have been taken down, and the stones removed for any purpose, the weathering has not affected them beyond what is due to the time they have been exposed. Every stone that had been removed, or fallen by the progress of decay, had been entirely broken up.

Weathering on so grand a scale, and limited in this way to a period of time absolutely definite, is very rarely to be seen, and I have thought it worth while to dwell at some detail on the facts and inferences. It is one of the most interesting points in the physical geography of the Ionian Islands, and one of the most instructive examples of a great natural operation everywhere going on, that has ever fallen under my observation.

There are not wanting peculiarities of climate and other local causes that help to account for these phenomena. The nature of the limestone itself is also very favourable, the rock being in that semi-crystalline state indicative of considerable purity, and peculiarly liable to an infinite multitude of minute crevices opening a way for and even inviting the action of water. The water that falls from the air in the shape of rain is always able to effect a lodgment in such rock; vegetable matter of one kind or other soon attaches itself, and the decay of this earliest vegetation is sure to contain the material for converting the oxidized water from the clouds into an acid solution acting rapidly on the stone. Thus each successive stage facilitates and hastens the operation. The climate being insular ensures a certain supply of rain at intervals through the year, and no doubt helps to advance the work. When there is room for the intrusion of the roots of a larger kind of vegetation than that which penetrates the surface, it is extraordinary to see how the natural expansion during growth is capable of lifting out of their places even the heaviest stones, and even occasionally building such stones into the very trunk of the tree. I have noticed this especially with regard to olive-trees in Santa Maura.

THE TELESCOPE.

BY JAMES BREEN, F.R.A.S.

THE lines of Wordsworth in which he seeks for the cause of his disappointment in looking through a telescope—a disappointment very frequently expressed by those who look through "optic glass" for the first time—are well known :—

> Yet, showman, where can lie the cause ? Shall thy instrument have blame—
> A boaster that, when he is tried, fails and is put to shame ?
> Or is it good as others are, and be their eyes in fault—
> Their eyes or minds ; or, finally, is this resplendent vault ?
>
> Or is it rather that conceit rapacious is and strong,
> And bounty never yields so much but it seems to do her wrong ;
> Or is it that when human souls a journey long have had
> And are returned into themselves, they cannot but be sad ?

The bard of Rydal was, however, but an indifferent judge of what should be expected from a telescope. On a subsequent occasion, whilst gazing through one of the finest and largest instruments in the kingdom, the appearance which most attracted the "poet's eye" was that presented by a star or planet with the eye-piece out of focus, when with its coloured fringes and prismatic rings it assumed, as the poet himself expressed it, that "beautiful bird-of-paradise aspect" which is not at all popular with opticians, who much prefer distinct and colourless images.

It must, however, be confessed that many are disappointed with the telescopic appearance of the brightest single *stars*, which appear smaller the more perfect the instrument. It is different indeed with the larger planets, the sun, but above all the moon, which latter, with its vast and rocky mountains, particularly during its first and last quarters, is always a glorious object. In a large instrument, too, the sight presented by the resolution of one of the globular clusters, where thousands of stars are huddled into a space apparently but a few inches in diameter, is wonderful in the extreme. Perhaps, however, in all of these the amateur observer is more or less disappointed, when he hears that he is looking at those glorious orbs with powers magnifying from five hundred to a thousand times,—not considering how far they

are removed from view even when the distance of these remote objects is diminished by that amount.

When the telescope (whether that discovered by the Tuscan artist or German optician) first revealed the glories of the heavens, it was imagined that by the simple combination of an eye-lens and a single object-lens, the problem was completely solved, and that the principle at least could not be improved. It was seen indeed that it gave indistinct and coloured images, and these latter for a long course of years baffled every endeavour to correct them, and it was not until a century and a half after the invention of the telescope that they were finally removed, and that objects seen through this instrument appeared perfectly colourless and well defined. The causes of the imperfection of the original telescope were that the rays of light could not be made to meet at the same focus, and this was also the case with the colours of which the original ray of white light is composed, and which was decomposed, as by a prism, into its original parts by its passage through the lens. These are technically called *aberrations* or deviations—the first, resulting from the figure of the object-lens, is termed the *spherical;* the latter, which depends on the glass itself (all homogeneous transparent media being affected by this cause), is called the *chromatic* aberration.

The spherical aberration arises from the circumstance that of the parallel rays passing through the lens A B (fig. 1), those near the margins of the glass will be bent or refracted to the focus *f*, whilst those passing nearer the centre of the lens will arrive at their focus at the point *f'*. The distance between those points is termed the longitudinal spherical aberration. If we look at the image of the sun thrown through a convex glass upon a dark screen, it will be noticed that instead of a point of light, the so-called focus will be surrounded by a halo. But if the outer margins of the lens be hidden by an annular diaphragm, it will be seen that less haziness exists and the focus becomes more distinct at the point *f'*. By giving certain curvatures to the lens the spherical aberration may be greatly diminished, although not altogether got rid of by using a *single* lens, at least by one having *spherical* surfaces. For instance, in a plano-convex lens with the plane side turned towards the parallel rays, the distance *f f'* is four and a half

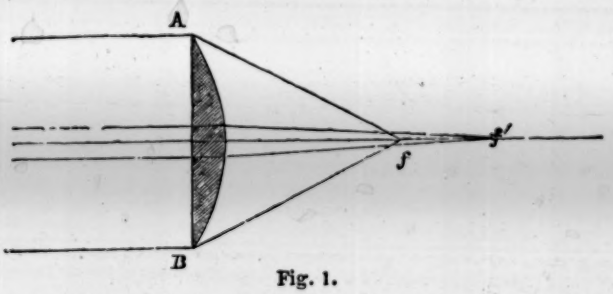


Fig. 1.

times the thickness of the lens at the centre. The smallest aberration takes place when the lens used is a double convex one, the radii of the spherical surfaces being as one to six, and the more convex surface being exposed to the parallel rays, in which case the distance ff' amounts to one and one-fourteenth of the thickness of the lens. The spherical aberration can likewise be corrected by making use of elliptical and other curves instead of spherical, but the latter from their simplicity are now always preferred.

The greatest objection to the use of the refracting telescope with one lens was, however, the fringe of extraneous colour which surrounded all the objects. In a homogeneous convex lens of glass the violet rays are bent much more than the red, so that the focus of the former V (fig. 2) is situated nearer to the object-glass than the latter R, and the other coloured rays have their foci between those two points. It has been calculated that in a lens with a focus of twenty-seven feet, the distance between the foci of those two points amounts to one foot. The confusion of the coloured images resulted, and which even Newton regarded it hopeless to think of correcting, was at length got rid of by Dollond (though it had previously been found out by Hall), and is considered to be the greatest optical discovery of the eighteenth century. By making use of prisms of different liquid or solid transparent substances, it was found that the separation of the ray of white light into a coloured ribbon was not always of the same length, nor had it the same position in respect to the incident ray. From this Dollond hit upon the happy idea that it might be possible, by combining two transparent media of different *dispersive* powers (as these changes were called), to bend a ray of white light out of its original path without separating it into coloured rays. He found that by placing a prism of crown-glass with an angle of thirty degrees in front of another of flint-glass with an angle of nineteen degrees (the angles being opposed), that this result was completely attained; and as a lens may be considered as a series of prisms, it followed that if a convex lens of crown-glass A B, (fig. 2) were placed in front of a concave lens

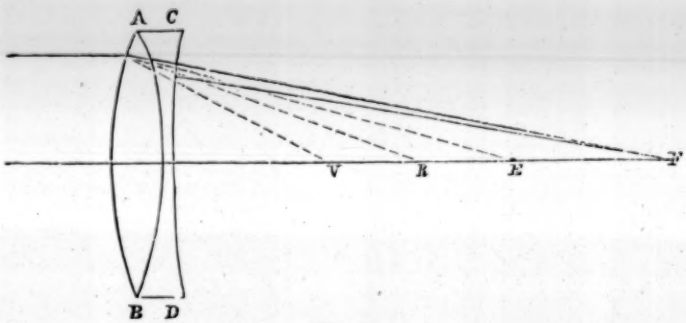


Fig. 2.

of flint-glass C D (with focus at E) formed to the correct curves, a colourless focus might be thus obtained. The result was the achromatic telescope. The aim of the optician was henceforward, therefore, to adopt the truest curves in which to grind and polish his glass, and to seek to unite the violet and red rays at the true focus F. Should the violet ray still be behind the red one, the telescope is *under-corrected;* but should the flint-glass, on the contrary, err on the opposite side, the violet ray will have a focus beyond the red one and the convex glass be *over-corrected.* The discovery of Dollond, it may be imagined, created great interest at home and abroad, and was a great boon to astronomy, as the celestial bodies could now be seen equally as well, if not better, with telescopes of four or five feet in length than they formerly had been with tubes of ten times those dimensions. For upwards of half a century the English achromatic held the monopoly of the market, and it is even said, led to a profitable smuggling business; and yet we believe that before the year 1828 an object-glass exceeding six inches in diameter had not been executed in this country.

The great difficulty lay in obtaining discs of glass proper for the purpose. It had not only to be pure, but beyond suspicion, and so many tests could be applied to examine its quality that very few specimens escaped without the detection of some flaw. If a skilful optician, following the advice of Mrs. Glasse, could first catch that material, the subsequent operations would give him far greater pleasure than toil, although immense labour and patience are required in grinding it in an iron basin and polishing it with mysterious powders and secret contrivances, of which each professor of the optic art has his own. The first discs of any size were those constructed by Guinand, who by his own unaided exertions produced specimens eight inches in diameter before the close of the last century, and subsequently, in conjunction with the greater genius of Fraunhofer, produced that miracle of skill—the Dorpat telescope of ten inches aperture. The successors of Fraunhofer have surpassed him in glasses ranging up to sixteen inches in diameter, which for definition and absence of colour are equal to the Dorpat, whilst exceeding it enormously in light-giving powers. What progress has been made by our own opticians might be seen at the last Exhibition. Various specimens of excellent and large foreign telescopes are to be met with in this country; indeed, the three largest of Cauchoix, of a foot in diameter and upwards, are in Cambridge, London, and Sligo.

It is not every one, however, who has an opportunity of possessing, or of looking through a telescope of these great

dimensions. Nevertheless, much can be done with an instrument of even moderate size. Messier discovered some score of comets, and upwards of a hundred nebulæ and clusters, with a five-feet telescope. The great map of the moon—the standard one by Baer and Maedler—was delineated by an instrument of scarcely greater power. M. Goldschmidt has detected upwards of a dozen of planets with instruments ranging from a common opera-glass to telescopes of about four inches in aperture; but in this case a most extraordinary keenness of sight must aid the unwearied diligence and patience of the observer. Although Maedler states that only two hundred nebulæ can be detected with a telescope of five inches aperture, yet D'Arrest assures us that he can see that number with a common hand-telescope or comet-seeker, whilst with an instrument of four inches aperture upwards of a thousand are visible. A great deal, in such cases, depends upon practice; but a few precautions being taken, the amateur will, in a short time, be encouraged to proceed, by looking at the same objects at different times. Probably, he may notice that some stars which were pointed out to him as double, appear only as hazy and ill-defined single ones on one evening, whilst a few nights afterwards, with the sky apparently no clearer, they may be transformed by some magic process into what he had been originally apprized of. The state of the atmosphere exerts a wonderful influence on the definition of objects. Herschel, we believe, only allowed a hundred hours of superfine observing weather during the year. Secchi (at Rome) confesses he is more fortunate, and owns that under the cerulean sky of Italy he is favoured with a clear fifteen nights throughout the year. And yet those two observers have been constantly on the watch for those happy moments, not one of which, the latter tells us, should be lost, but the telescope at once directed to the faintest and minutest objects. We have ourselves found, that the best definition and brightness exists when the wind is from the damp southerly and westerly quarters, and the worst when from the dry north and east, particularly the latter. It is important to avoid placing the telescope at a window, especially when the atmosphere within is of a higher temperature than without; and Herschel goes so far as to say that no roof with an opening, or even shady places in the open air, should be allowed. The same authority tells us that sudden changes from frost to thaw, or *vice versâ*, are bad for definition. Above all, good definition need not be expected near the horizon, where undulations, mists, and scintillations give a boiling motion at the best of times, and render observation impossible. It is necessary, above all things, to keep both the object-glasses and eye-pieces

scrupulously clean; for this purpose a piece of old lawn is much preferable to silk, and some say a well-crumpled piece of tissue-paper to either. When the instrument comes from a good maker, the centering of the object-glass and its proper position in its cell has doubtless been duly taken care of, and should not be disturbed. Sometimes, however, the glasses of both the object- and eye-lenses are pinched too tightly, which distorts the images fearfully; a little unscrewing will at once set this to rights.

The ordinary achromatic refractor is composed of simply the object- and eye-lens, without any intermediate glass. This latter, however, like the former, consists generally of two separate lenses, although both are of the same sort of glass. The negative eye-piece consists of two plano-convex lenses, the plane sides being turned towards the object-glass, and when made of crown glass, separated by a distance equal to half the sum of their focal lengths. When measuring apparatus is attached to the telescope, an eye-piece is employed, formed of two plano-convex lenses of equal focus, separated by a distance equal to two-thirds of the focal length of one or other and their convexities opposed in the tube. This is called Ramsden's eye-piece, and gives a flat field of view, with the advantage already mentioned that a system of spider lines, or cross wires, can be distinctly seen at the same time as the double star, or planet, whose distance or diameter is to be measured. Both of those are inverting, but this is of small account in looking at the heavenly bodies. The erecting eye-piece, consisting of four lenses, although admirably adapted for land use, is never made use of for the latter purpose, as each lens tends to obstruct the light which is so precious when gathered to a focus. It need scarcely be added that the eye-piece must be adjusted with the greatest possible nicety for different sights. This is easily done by the rack and pinion motion after a few trials, whether upon the edge of a planet or by judging of the appearance of a double star, or by the visibility of the faintest single stars in the field of view.

With an instrument of three to four inches aperture (and a good one of the latter size will bear a magnifying power of from 300 to 350) the belts and markings on Jupiter, the snows of Mars, the ring of Saturn, may be well seen; and the spots and faculæ of the sun, and all the gorgeous phenomena of the moon, rendered most perfectly. The nebula of Orion surrounding the trapezium will likewise amply repay curiosity on clear dark nights. Some hundreds of double stars—shining in all their different lustres, colours, and distances—are a constant source of pleasure. In addition to these, many clusters and nebulæ may be seen with such an instrument.

Mr. Dawes has been able to separate some exceedingly close double stars, and observe some very faint ones with such a telescope. The amateur will soon get accustomed to the difficulty of the various objects, and know what powers to apply, according to the fineness of the night or other circumstances. Admiral Smyth—one of the most successful observers of the age—advises the amateur not to be afraid of his small instrumental means, but to look at everything; and it is certain that with some costly apparatus much less is seen than with less pretentious affairs.

For small instruments, the ordinary tripod stand, with slow motion in altitude and azimuth, is as convenient as any, where merely viewing the object is all that is required. For larger ones, where measurements of the positions and distances of double stars are to be obtained, the telescope is mounted equatorially—the support of the instrument, instead of being pointed to the zenith, being placed parallel with the axis of the earth—by which means, by merely shifting the telescope to the right, the star is always in the field of view without any vertical motion. To most large instruments strong clockwork is attached, by which this motion to the west is duly regulated, and the observer has only to keep his eye to the telescope, which of itself follows the star. Although in the last century and the time of Sir W. Herschel reflectors of from six to ten feet were greatly in use, yet of late years, in the case of small telescopes, it has been almost completely superseded by the refractor, and on that account we have confined our observations to this most convenient description of optic tube. Unless extreme care is used with a reflector, the metal mirror is very liable to become tarnished, whilst dew or dust settling on a glass lens can easily be wiped off with a soft cloth. In France, however, small reflectors are again coming into vogue, the mirror being formed of glass and coated with a thin film of silver; and as the latter has a reflective power of 91 to 67, in comparison with speculum metal, it has a great advantage in this respect; but, unfortunately, tarnishes very readily. As, however, the silver film is easily renewed, this is of the less consequence. We had the pleasure of inspecting several instruments of this description by the celebrated M. Foucault, at Secretan's establishment at Paris, some time since, which were beautifully fitted up. A reflector of about forty inches aperture has since been made by those gentlemen, and as it was with one of those glass mirrors that the companion of Sirius has been detected, it may give an idea of their merit.

The largest refracting achromatic telescope we have seen, and which we believe to be at present the largest in the world,

is that made by M. Porro, and which still remains at Paris. The object-glass is 54 centimetres in diameter (21·26 inches) and has the immense focal length of 15 metres, or nearly 50 feet. It is mounted with an azimuth and altitude motion, and at first sight looks like a gigantic fire-escape. The tube is composed of three hundred pieces of wood joined together by three thousand screws. Great controversy has arisen respecting the merits of this instrument; but M. Bulard, the astronomer at Algiers, asserts that he could see everything with it that he had with Earl Rosse's 6 feet mirror; and M. Porro states that he has detected two new stars within the trapezium of Orion. It is certain, however, that although in existence for six or eight years, it has been very little used. Comparing this immense instrument with the modest five-feet telescope of M. Goldschmidt, erected on a moveable tripod stand in his garden near Paris, and with which he has discovered so many planets and variable stars and nebulæ, and made so many curious observations, it will be seen what may be done with care and patience even with small means.

Should the observer be provided with a telescope mounted equatorially, he has simply to set the declination and hour circles to the object required, and of which he has of course the right ascension and polar distance given. In other cases, in searching for any particular object, he must make use of an ordinary star-map divided in the usual manner into right ascensions and declinations, on which having marked the position of the required nebula, comet, or double star, he guides the direction of the telescope by means of the bright neighbouring stars of the constellation in which the object is placed; and with a little management this operation will soon become easy. In the same way, to find any particular planet, its place on the required day will be taken from the "Nautical Almanac," or any similar work. Great assistance in the choice of stellar objects will be derived from Admiral Smyth's "Celestial Cycle," in which the most prominent clusters, nebulæ, double and variable stars are fully described, and full particulars given of their positions, brightness, and difficulty. In pointing the telescope, the observer makes use of the small side tube, termed the *finder*, which, giving a large field of view, helps him in the *alignement* of the faintest stars marked on the map. In searching for comets, the lowest power of the telescope should be made use of; and if a nebulous object be caught sight of, its place should be transferred to the map, in order to determine whether any fixed body of that character has been before observed. In all cases it is almost useless to search for objects with high powers, which not only gives a small field but renders them very faint. It will be found that

the eye will distinguish faint objects much more readily by keeping in the dark a few minutes previously. The observer will remark some anomalies in different eyesight; some which can distinguish very faint objects are unable to separate a close double star, and *vice versâ*, and in many instances the colours of double stars will be judged differently. We need not state that a comparatively small telescope, in which the glass is pure and the figure polished to the true curves, will be found far more useful and pleasant to handle than a much larger one in which these conditions are forgotten. The excellence of the object-glass is the principal affair, and no beauty of mounting will compensate for this want.

In observing double stars, those which are well separated should be scrutinized at the commencement and the distances and magnitudes gradually diminished, until the most delicate objects which the instrument can bear are arrived at, and for which a very clear and favourable sky will of course be necessary. The observations of the double and multiple stars are the finest test for the performance of a telescope. Thus, commencing at the coarse double Delta and Kappa Herculis or Eta Lyræ, he may ascend to Theta Serpentis and Alpha Can. Venat. From Zeta Ursæ Majoris and Beta Cephei he can pass to Gamma Delphini and Eta Cassiopeiæ. Closer still are Alpha Herculis, Kappa Cephei, and Mu Cygni. Coming to those which are test objects for small instruments we have Gamma Virginis, Mu Draconis, Rho Herculis, Zeta Aquarii, &c., whilst on very favourable nights the observer may look for Delta Cygni, Pi Aquilæ, Xi Ursæ Majoris, Sigma Coronæ Borealis. All these stars are visible at the present time of the year, and their places marked on a good celestial globe. The amateur observer has only to transfer those positions mentally to the real heavens, which, with a little practice, will be as simple as finding any geographical position on a terrestrial globe by knowing its longitude and latitude.

CONTRIBUTIONS TO THE HISTORY OF THE ROTIFERA, OR WHEEL-ANIMALCULES.

BY PHILIP HENRY GOSSE, F.R.S.

PART IV.

THE FLEXIBLE CREEPERS (NOTOMMATINA).

UNINITIATED persons are sometimes startled, and not a little stumbled, by reading in books of scientific natural history such statements as this: "*A*—— *b*—— is a much more perfect form than *C*—— *d*——." They pause and ask whether there can be any degrees of perfection in the handiwork of the All-wise and Almighty God. Are not all His works perfect? The answer must be that they are; understanding the term to express the adaptation of the creature, and of all parts of its organization, to the purposes for which they were designed.

The naturalist, however, does not mean this. He is not speaking of the organism as an individual, with reference to its own objects and requirements; but as one of a series, with reference to an ideal standard of aggregate qualities presented by that series. Thus, when we consider Birds, we have before us a vast assemblage of creatures, the most prominent and characteristic feature of which is that they are constituted for flight, by means of a peculiar development and arrangement of tegumentary organs (feathers), associated with peculiar developments and arrangements of the skeleton, muscles, and breathing organs. Thus, then, we acquire a definite idea of a bird, notwithstanding that this idea is presented under considerable diversity in all these details, when we examine the thousands of species that are known; nor does this diversity at all interfere with the unity of the model or pattern which is involved in the aggregate idea of a bird. The comparison of these details, however, soon shows us that the characteristic features of a bird are much more prominent in some species than in others. In the humming-bird, the frigate-bird, or the swift—in the great breast-bone, the enormous lungs and chains of air-cells, the hard, dense, thick pectoral muscles, the firm rigid feathers, drawn out to

long points on the wings and tail,—we see a high concentration of all the characters of a bird, as I have enumerated them above. Compare now with these the Guinea-fowl, with its short hollow wings, and small, weak, excavated breast-bone; the tame duck, with its soft feathers and short, powerless tail; or the penguin, or the ostrich, in which the wings are reduced to mere rudiments, and have absolutely ceased to be flying organs; and you will see what the ornithologist means when he speaks of the comparative perfection of these birds, when he says that the humming-bird is the most perfect representative of birds, the penguin the least. It is not that the penguin is not most admirably fitted for its mode of life and its requirements;—nay, it exhibits some adaptations of structure to function which surprise us by their wondrous fitness. *As a creature* it is perfect, but not *as a bird;* there is a manifest departure from the characteristic structure and functions of a bird, and an approach to those of some other great model of animate existence, while it still remains essentially a bird. It is, perhaps, the least perfect of birds.

It is the same in the subordinate divisions. The swallows, taken as a family, are very perfect representatives of their class in the points above-mentioned; but there are degrees of perfection among them. The swifts possess the characters which mark the family in a higher degree than the swallows; while of these latter, how much more completely, "more perfectly," a swallow, is the chimney-swallow than the sand-martin.

Naturalists have been accustomed to use the technical term "type," or its adjective "typical," to express the greatest aggregation of characteristic features in any given group. Among birds, the perchers constitute the typical order; in this order the cone-billed birds take the typical place as a tribe; the finches, again, are the typical family of these; and what is the type of these pretty little birds, as I am not writing an essay on ornithology, I shall leave to my readers' acumen to determine.

There must always be some latitude in the determination of what constitute the typical characters of any given group, and therefore of the types themselves. One naturalist may picture to himself a different standard of completeness from that which another of equal eminence would assume; and hence no one ought to speak oracularly; he merely gives his judgment. The great group of tiny creatures of which I am about to treat is, according to my judgment, the typical order of the class ROTIFERA. They may be designated, in homely parlance, The Flexible Creepers; systematically,—

the order *Notommatina*.* One mark of a typical group, almost constant, is that it contains a larger number of subdivisions than any other group of like rank; and populousness is highly characteristic of the *Notommatina*.

All these animals are permanently free, never becoming fixed to other objects, and never forming mutually adherent groups. Their bodies are not inclosed in a tube; and their skin is for the most part flexible, not forming a shelly mail, though in one or two genera certain portions of the integument are stiffened, indicating an approach to the structure of the mailed families. The form is generally cylindrical, with a length about twice the diameter on the average, occasionally, however, three or four times the diameter. The front does not expand into a flower-like disk, but is usually no wider than the body, very varying in its shape, sometimes being flattish, oftener convex, with many swellings, beset with strong vibrating cilia, which are so arranged as that their combined action produces two vortices, one on each side of the head. The opposite extremity of the body terminates in a thick foot of several joints, of which the last bears two diverging toes. These are used by the animal for its support, to aid it in crawling. They are in general moderately short, but in a few cases are of great length.

The characteristic appearance of the little animals of this order will be seen by reference to Plate XIX., in which figure *a* represents a dorsal view of *Eosphora aurita*, in the act of swimming. This is an elegant and sprightly species; especially beautiful when, as is very frequently the case, the enormous stomach and intestinal canal are filled with translucent green food. I have repeatedly met with it around London; as in a green pond in Greenwich Park, and in the tiny sweltering pools on Hampstead Heath, renowned, for more than a century, as being prolific nurseries of the higher forms of ROTIFERA. They will live and increase their race in a phial of water containing a little growing vegetation, as a sprig of water-moss, a few leaves of duckweed, or a small tangle of converva: the phial being left uncorked, and set in the light, but protected from the direct rays of the sun. Here they will play and rout about, delving in the sediment that

* This order is nearly concurrent with the family *Hydatinæa* of Ehrenberg. But the genus *Hydatina*, which he considered typical, and whose name he used for the family appellation, consists of only a single species, and cannot be separated from the great genus *Notommata*, except by the very trivial and valueless character of wanting an eye; or rather, of wanting the speck of coloured pigment which ordinarily accompanies the eye. *H. senta* is a true *Notommata*.

accumulates on the phial's side for food; now and then shooting off into the water, and swimming evenly and gracefully along, slowly rotating on their long axis as they go. Their movements can be watched, and their forms distinctly made out, with the aid of a good pocket-lens, as the phial stands on the window-sill; and this sort of observation, which is highly interesting, can be pursued with great ease and satisfaction, especially if the finger of the disengaged hand be passed behind the phial (without shaking it), so as to intercept those rays of light which pass direct from the sky through the animalcule to the eye of the observer. The effect of this manœuvre is to make a dark back-ground for the object, while it is yet brilliantly illumined by the rays that fall on it from all around the finger. Small as is the magnification, the experienced observer has no difficulty in distinguishing the principal organs, which, under this mode of illumination, have a relief and a solidity which are very instructive.

But I must describe our little beauty in detail. Its body is nearly a cylinder, of about a hundredth of an inch in length, with a diameter of one-third the length. Sometimes it becomes almost pear-shaped, by the swelling out of the hinder half of the body, when an egg is maturing in the ovary. In the ROTIFERA generally, the eggs are of immense size in proportion to the body; and in this species they are even larger than usual, an egg just ready for discharge occupying nearly one-fourth of the entire volume of the animal. In the figure such an egg is seen occupying a large space just behind the middle of the animal.

The head is capable of considerable alteration in shape. When the animal is busy feeding, resting on its two-toed foot, with the body thrown forward horizontally, the front of the head is so oblique that, by a little bending downward, producing some strong foldings of the skin of the breast, it can be brought, as a nearly flat surface, into contact with the ground. A specimen is represented in this position, under a lateral view, in fig. *b*. The action of the frontal cilia is then seen, as if evenly covering this surface, producing currents, which, however, do not form whirlpools. But suddenly the little animal ceases feeding; rears itself on its toes till it stands nearly erect; balances itself for a moment; evolves from each side of the head, by a kind of turning inside-out, a remarkable ear-like process, which is clothed with much stronger cilia. The action of these immediately begins to form vigorous circular vortices, of which the "ears" are the centres, and in the same instant the animal shoots forward with beautiful ease and precision, on its even course, revolving slowly as it goes.

Some very favourable observations on the animal, made when I could look down directly on the head in a vertical position, have revealed some organs, which are doubtless vehicles of sensation, though I can but very uncertainly conjecture their office and value. At the back of the head there are two very minute prominences, each of which is terminated by a tuft of bristles. These organs are very generally found in the wheel-animals, and are in many species much more developed, and more favourably situated for observation, than in this case. They appear to be tubular prolongations of the skin, within which a piston-like body moves to and fro, carrying at one end a tuft of bristles, which diverge when protruded from the tube, and attached by a muscular cord at the other end to the interior of the body. A nervous thread in some species is seen to pass from the brain to each tube. The organs may be considered as analogous to the antennæ of insects, though even of these we are not quite sure of the function.

In our *Eosphora* there is seen, seated in a central depression between these two antennæ, a little wart, of which I cannot suggest the purpose. Directly at the front of the head, at the most advanced point of the animal, whether creeping or swimming, there are placed two symmetrical round specks of opaque crimson pigment, which come out with great brilliancy when the animal is viewed under sufficient magnifying power by reflected light. Dr. Leydig refuses to allow these to be organs of vision, but from repeated examination of them I have no doubt that he is in error, and that Ehrenberg was right in considering them eyes. Besides these, however, there is another red speck, which is without dispute of a visual character. It is far remote from the two frontal specks, being situate within the transparent skin, but near it, on the dorsal aspect, at about one-fourth (following the curve of the back) of the distance from the front to the origin of the foot. To make my readers understand its relations, I must describe a highly interesting and very remarkable organ.

In most of the animals which constitute this order, but seen with peculiar distinctness in the present subject, and in one which very closely resembles it in appearance, *Notommata aurita*,—there is seen a great ovate sac passing from the front along the back of the head, and terminating by a rounded extremity in the neck. This is occupied by turbid matter, and seems to be indubitably a brain; though it is quite without parallel among invertebrate animals to find any such concentration of the nervous substance in a single organ. We are accustomed to consider this character as exclusively belonging to the vertebrate classes, and to mark their superior position in the scale of being; the most sentient, the most

intelligent, the most vigorous among the Invertebrata, such as the Spiders and the Insects, having no such simplicity of nervous structure, but only a series of centres, in the form of ganglions, more or less distributed through the whole body.

It must be borne in mind, however, that while, in the ROTIFERA, this brain is proportionally enormously large, and is quite alone—there being no other recognized concentrations of nervous substance than can be dignified with even the title of ganglions,—the neurine of which it is composed is in a very fluid condition; whence we may perhaps infer that its energies, whether for perception or will, bear no proportion to its volume.

Upon this great brain-sac, at the point that approaches nearest to the skin of the nape, but always with a forward aspect, there is seated a wart, often large and conspicuously hemispherical. The summit of this rounded eminence is crowned with a mass of red pigment, at times scarcely perceptible, then suddenly becoming visible like a flush of crimson, rich in hue, translucent, but sometimes pale and ill-defined. Upon this there lies a convex lens, which can, in many species —or, I should rather say, in many specimens of different species, for it is exceedingly variable and uncertain in this respect—be beautifully seen and clearly defined.

There is, in some species, a very curious and remarkable organ, in close connection with the brain, the use of which is altogether unknown. It is very distinct in this *Eosphora* and in *Notommata aurita*, and in one or two other species of the latter genus. It is a sort of globular sac, of large size, occupying the greater part of the bottom of the brain-sac, and sending up a rather wide tube through it. The globose extremity and a considerable portion of the tube are loosely filled with a substance, which, being opaque, appears dark when we view the animal by transmitted light; but when reflected light is brought to bear on it—a ray of the sun, for instance—it comes out quite white upon the general transparency. Ehrenberg assumes that it is of the nature of chalk, and so has called it *kalkbeutel*, or chalk-sac; but all that can with certainty be said is that it is a granular opaque white substance.

The appearance and motions of this organ and its contents add greatly to the interest with which the microscopist views one of these creatures. It is so unique, so unaccountable, so conspicuous, so beautifully defined, so evidently connected with the seat of intelligence, and with the most obvious organ of sense, that it exercises a kind of fascination on the observer, who is induced to watch it, and to linger upon it, in hope of solving the problems which it suggests. There, however, it

remains, unsolved as yet, an inviting fortress of research for daring young physiologists to scale and take.

Let me say what further I have observed on the matter. The sac itself is frequently drawn with force to one side or other, or down in the longitudinal direction, or across towards the breast. These movements are effected by means of slender muscle-threads, which are attached to it and to various parts of the body. The white substance lies in irregular masses in the sac, sufficiently solid to push out the elastic sides in wart-like knobs, but loose enough to allow the light to pass through the interstices as they move over one another. The walls of the sac are contractile; for we see its form change, and instantly some of the granules of opaque matter are forced higher up in the tube, rising and sinking by turns, like the mercury in a thermometer. Indeed, a thermometer, with its tube and its bulb, and their contents, affords a capital illustration of the whole organ. By means of their motions we are able to trace the course of the tube much farther than when it is empty, and to see that it passes to the front of the head, between the two frontal eyes, and, bending over with an arch, is lost somewhere in the ciliated face.

The transparent body is inclosed in an equally transparent skin, which is quite flexible, but apparently tough and strong, like wet parchment. It falls into transverse folds as the animal bends and wriggles from side to side, allowing much freedom of motion; and these folds have the additional advantage of allowing the body to be lengthened or shortened, at the will of the animal, at both ends; the skin becoming inverted at two or three points, when either the head or the foot is drawn in. Both these movements are almost every moment being performed, to a greater or less extent; and are quite distinct from the evolution and involution of the head itself, by which the rotating "ears" are suddenly turned out for swimming, or the contrary.

In all this order the muscular system is displayed with a clearness far greater than in any of the forms that we have yet considered. As might have been presumed from the untiring, vigorous, precise, and most varied motions of every part of these minute animals — motions which excite the admiration of the observer who remembers their dimensions, —the muscles are exceedingly numerous and well developed. In every species in which the viscera present the requisite clearness (for some are so constantly opaque, either from the distension of the alimentary canal with food, or the successive growth of great turbid eggs in the ovary, that we can hardly discern any of the more delicate details of their internal structure), the great longitudinal and diagonal muscles are

seen, in the form of broad tapes running freely through the body-cavity, inserted at each end into some part of the skin by terminations more or less branched and divergent. Some of these pull the head down, or to one or the other side, or to the back or front; some, attached at the infoldings, produce the telescopic inversions; some draw in the different joints of the foot, or move the whole foot, or each joint, in various directions, or separate the toes.

Other muscles are seen in the form of slender elastic threads, of which there are very many, crossing the body in various directions, attached by expanding ends to the different viscera and serving to move them quickly and vigorously. There are also bands which go transversely around the body, no one band, however, completing more than a part of the circumference: the action of these appears to be to narrow the breadth of the cavity, and so to protrude the extremities,—either the head or the foot, or both at once. Minute and complex muscles are also present in the interior of the head, and in the mouth (*mastax*) in great number, effecting the most precise and varied movements of these parts.

In order to render clear the form of the mouth in this order, I must again have recourse to a homely comparison. The parts, which, in the Builders,* I have endeavoured to illustrate by means of a cut apple and a set of pins, are all here, but they are so modified and changed in form and mutual relation that they can no longer be made intelligible by that device. Take away then the split apple, and substitute for it a pair of gardener's edging-shears, the blades of which stand in a different plane from the handles. Suppose there is but one handle (the pair being bound together, if you like), and the blades are hinged to its extremity so as to work while it remains fixed; now turn it up, so that the handle stands erect upon its top, and the blades work in the air nearly horizontally. If the blades were considerably widened, and curved downward at their tips like some surgical scissors, the resemblance would be perfect. These then are the lower jaws, technically termed the *incus*, the blades being the *rami*, and the handle the *fulcrum*.

Now then, for the upper jaws, we will again resort to the gardener's shed and rummage among his tools. We find a small digging-fork, such as can be used with one hand. It has three teeth, but that is of no consequence, for if it had but one, or any other number, up to seven or eight, it would still serve to represent the structure in some species or other. We take two such forks, and carry them away as lawful prize, in

* See "Popular Science Review," vol. i. p. 478.

the name of science. But these also must be modified a little. The prongs must be bent abruptly at about a right angle to the handle, where, however, a hinge-joint must be made, so as to allow this angle to be considerably varied. Now take these modified forks, and set them up one on each side of the blades of the shears, handles downward, at such a distance that the prongs shall just rest on each blade. These are the upper jaws, technically *mallei*, the prong part being the *uncus* of each, the handle the *manubrium*.

So we have the solid parts of this remarkable mouth. The prongs are fixed to the blades by elastic ligaments, so that when the former are drawn back the latter are stretched open, though both the blades and the forks have proper and independent movements, effected by means of muscles. The whole is contained in a three-lobed mastax, which does not importantly differ from that before described; and you may again have recourse to the parchment-covered cylinder of glass, to imagine the situation of the whole affair within the transparent body of the animal.

I have intimated that there is considerable modification in detail in these parts as found in different species. I have had specially in view *Notommata aurita* in my illustrative comparisons. In *Eosphora*, however, the blades are more pincer-like, coming together only at their tips, and the forks are but two-toothed, one tooth being more prominent than the other, and projecting over the blades, so as to cross with the tooth of the opposite jaw. In this, and in several other species, the mastax can be brought to the front of the face, so that the points both of the upper and lower jaws protrude; when so placed the animal frequently snaps them fiercely, and their close analogy with the two pairs of jaws in a carnivorous beetle becomes very evident; an analogy which, if we saw them only as they occur in many kinds of ROTIFERA, permanently inclosed far within the cavity of the chest, we could scarcely have imagined. It was this and similar observations which first compelled me to identify what has been commonly miscalled the "gizzard" in the ROTIFERA with the mouth and horny jaws of Insects.

The protrusion and snapping action of these two pairs of jaws are very strikingly exhibited by an attractive and beautiful race, the animals of the genus *Synchæta*. These are mostly found in large collections of clear water, such as lakes and ponds and reservoirs; rarely or never in those minute stagnant pools and ditches in which many ROTIFERA delight. They appear to require a wide area in which to expatiate, and the element must be of the purest, or it will not do for *Synchæta*. In such collections of water animal life is usually

very scarce: statements which we see hazarded in common compilations of natural history, and slavishly copied and re-copied upon no authority, and with no test of their truth,—that "millions of animalcules inhabit every drop of water that we drink;" that "all the waters on the earth are absolutely swarming with life," and the like, are gross exaggerations. I have often examined with care samples of water from different localities, and in particular that supplied to the inhabitants of London by the different water companies, and found scarcely a trace of microscopic life,—no *Monads*, no *Euglenæ*, no *Infusoria* of any kind, no *Entomostraca*, no ROTIFERA, with the exception of a solitary *Synchæta*, or two, perhaps, spinning round, or two or three *Polyarthræ* jumping hither and thither, in a whole tumblerful. Sometimes such water is a little more peopled than at others; but its tenants are always, as a rule, few and remote. Like most popular fallacies, the notion I allude to rests on a substratum of truth; there are waters of which it would be strictly true to predicate such facts; but they are stagnant collections, usually very limited in area, in which decaying organic matter, vegetable and animal, affords abundant nutriment, in consequence of which the increase of animalcules, both by generation and spontaneous division, goes on with almost inconceivable rapidity.

To return, however, to our *Synchætæ*, the bright sparkling tenants of bright sparkling waters. They are comparatively of considerable size, several species being just discernible with the unassisted eye, — in other words, being above one-hundredth of an inch in length,—which, with a proportionate width, is about the limit of ordinary vision under favouring conditions. Their characteristic form is that of a boy's peg-top, especially if you select a specimen of the article with which Tommy Scapegrace has been for a week or two pertinaciously "digging" at his fellows' tops, by which means the iron peg has been driven further and further in, till only just the point projects: then you have the *Synchæta* exactly, the projecting point representing the minute foot with its tiny toes, which are commonly pressed together so as to look single. Now and then the animal rests on these united toe-tips, and rotates for several minutes, as if to maintain its character as a spinning-top; then away it shoots, and glides swiftly and giddily through the clear water by the hour together without repose; its enormous ciliary apparatus giving it great power of motion. The rounded front appears to be beset with cilia, but it forms a sort of indented crest or forehead, on which two antennæ are seated, as well as some pairs of curious stout branched bristles—whence the generic name, from σὺν (*sun*), together, and χαίτη (*chaite*), a bristle—and which then descends on each side in

the form of two hanging lobes or ears, which are richly clothed with vibrating cilia, and are powerful auxiliaries to swimming. Strong circular currents are formed around each ear, while the animal rests on its toes. As it swims, it is almost continually contracting the enormous head with a sort of spasmodic twitching, which brings the ear-lobes momentarily to point forward, and alternately, and almost as quickly, recovering itself. The conical lower parts of the body are also frequently contracted in various degrees, and drawn up to either side in the most irregular manner. These movements are made by the various muscle-bands and threads, which exist in great number, and are discerned to much advantage, owing to the crystalline clearness of the tissues. This brilliant transparency is highly characteristic of the tribe, and, combined with their elegant form and sprightly motions, makes them rank among the most charming representatives of the class.

Just below the centre of the frontal crest there glows a very large oval eye of the richest ruby-crimson, through which the transmitted light is strongly refracted, as it would be by a globe of glass, showing that it is furnished with a true lens. This eye rests on a great mass of brain-substance, which when viewed from behind is seen to be much extended laterally. On each side of the eye are some large irregularly globose knobs of clear substance, from which descend two thick pieces, which meet at an angle near the middle of the body in the form of a massive **V**. From the summit of the frontal crest every now and then the animal protrudes two pairs of dark tooth-like points, curved towards each other, which open and close with a sudden snapping action, and are instantly withdrawn below the crest, where they can scarcely ever be discerned. For a long time I watched the recurrence of this motion, and marked the momentary protrusion of the jaw-teeth with the greatest interest, but with a most tantalizing impotence to solve their mystery. So totally unlike they seemed to the mouth apparatus in any other genus, that I longed for years to understand them. I saw by certain accompanying twitchings in the globose heads of the **V**-shaped body, that the protruded points were intimately connected with them; and I felt sure that if I could satisfactorily resolve them, I should acquire a flood of light on the as yet unintelligible structure of the mouth in the whole class. At length I thoroughly mastered it, and saw that it was by no means an abnormal apparatus, but essentially identical with the parts of what had been called the "gizzard" in the ROTIFERA generally.

The two branches of the **V** are the *mallei*, or upper jaws, invested with thick masses of muscle: the hand, or "fork,"

consists of a single finger, the tip of which as a sharp curved point projects from the investing muscle, which here becomes globose. A delicately subtle rod which rises between the limbs of the V is the *fulcrum* of the lower jaws, seen at some distance forward, whose blades curve backward towards the beholder (as he looks at it dorsally); the whole being well imitated by the figure of the garden-shears. The blades, however, are invested with thick globose masses of muscle, out of which the tips project, as the inferior pair of snapping points. It is the massive character of the muscular investments which during life so disguises the form of the apparatus; and this massiveness, as well as the inordinate size of the whole structure, amounting to fully one-third of the entire bulk of the animal, indicates a predatory power which is by no means inconsistent with the impression of ferocity conveyed by the vigorous, sudden and frequently-repeated snappings, even when there seems nothing present to snap at.

I have mentioned above the name of the genus *Polyarthra*. It is a member of this order, but with peculiarities which isolate it from all others of the class. This, too, is a very difficult subject to make out, and it requires a long-continued study of the species, pursued through a great multitude of individuals, and a large acquaintance with other forms for comparison, well to understand its internal organization. This difficulty is augmented by its swift motion, its irregular fitful leaps, and its extreme transparency, combined with high refractile power.

Its form is that of a crystalline cup, somewhat like the body of a wine-glass without any foot, but bearing many thin, sword-shaped processes, which proceeding from the breast commonly lie flat on each side down the body, the points projecting below. These are evidently stiff and highly elastic, and their use is manifest to any one who sees the creature in active motion. It swims with a rapid gliding progress head foremost; but at almost every moment it makes a sudden forcible jerk or leap backwards, or to one side; and that so quickly, that the eye often cannot follow it in the transition. The organs by which these jumps are effected are the long breast-spines, which are suddenly thrown out in various directions, and they may frequently be seen extended the moment after a leap, before they reassume their normal position. When we consider that the creature is jerked often four or five times its own length through so dense a fluid, we shall perceive how strong the muscular action must be which moves the lever-like spines. The creature is thrown irregularly, often with the side foremost, or the back, or made to perform a somersault in the act. It is probably a sensitiveness to

danger or annoyance that prompts these violent leaps; at least it frequently performs them after a momentary examination of any floating matter with which its course brings it into contact.

This very remarkable animal deviates in several particulars from the rest of the order, and yet I think its affinities are with them. It has no semblance of a foot, and the investiture of the body forms a stiff shell (*lorica*), as we find in the following order. Yet this is very peculiar. The back appears to me to be covered with longitudinal plates, divided from each other, and crossed by very delicate, close-set lines (*striæ*). These plates appear to extend round to the ventral surface, protecting about one-third of the width on each side, and rising into a strong lateral point. The central third is occupied with membrane, which along the breast between the lateral points is rigid and shelly, but becomes quite flexible and skin-like towards the hind extremity.

The sword-like fins are exceedingly curious and quite unique; for though a genus named *Triarthra* is furnished with three long spines, by which it performs leaps, yet the structure of these organs is very different from that of the swords of *Polyarthra*, and the animal's affinities are with another order. These appendages are exquisite tests of the powers of the microscope, as well as of the skill of the observer. They are twelve in number, arranged in groups of three each, one group being set on each side of the dorsal, and one on each side of the ventral aspect, near the base of the projecting points of the breast. They are jointed, quite independently, on rounded shelly knobs, and are moved by strong muscles. Under graduated pressure I have brought out the four series of knobs, and the twelve fins with perfect distinctness, and have proved that the connection is that of true proper joints, like those of the limbs of insects. This existence of true joints, which is found in several other species of ROTIFERA, is one of the characters, on which I rely in maintaining, contrary to the opinion of Mr. Huxley and other excellent naturalists, the high place of the class in the natural system.

The fins are what botanists would call linear-lanceolate; very thin, with a midrib running throughout, acutely (in one case that I observed, rather abruptly) pointed, distinctly toothed along each edge, the teeth pointing forward. Their texture is excessively delicate, and shows oblique lines running to the notches; yet they are firm and highly elastic.

The female carries its eggs, after they are discharged, attached to her body for some time; another particular in which the species agrees with the *Brachionidæ*. The young student must, however, be on his guard against a very natural

mistake into which I myself fell in my early study of these forms. Observing that many specimens of this species had little green egg-shaped objects adhering to their bodies, and knowing the egg-bearing habit of the species, I took for granted that these were the ova. At length, however, a specimen occurred with one or two manifest eggs, of much larger dimensions, and perfectly agreeing in form, colour, appearance, and proportions with the eggs of other ROTIFERA, adhering to the body, while the little green objects were there also. At length some of these latter, detaching themselves, swam away by means of their own cilia, and I perceived that they were parasitic INFUSORIA, of the genus *Colacium*, which ordinarily infest this species, as well as ENTOMOSTRACA. Thus maturer observation corrects the errors of inexperience.

One of the most remarkable forms of this order is the genus *Asplanchna*, so named because of a most strange and quite unparalleled deficiency in its organization. Furnished with a formidable pair of nipping jaws, a long gullet, a capacious lobed stomach, and a distinct pair of pancreatic glands, and being highly predatory and carnivorous, this animal has not the slightest vestige of an intestinal canal, the digestive stomach hanging like a globe in the centre of the capacious body-cavity, tied to various points of the walls by long elastic slender muscle-threads, which allow it to sway about. From the great comparative size of the animals—for they are among the very largest of ROTIFERA,—from the brilliant transparency of the skin, and from the smallness and paucity of the viscera in proportion to the capacity of the ample body, the organs can be determined and examined with unusual facility; so that I know of none that present so favourable opportunities to the student who wishes to demonstrate the anatomy and physiology of this charmingly crystalline tribe of animals.

It is interesting to remark that the ovary in this genus is of the ordinary structure, though small. The young, however, are hatched, one at a time, within the body of the parent; and an exceedingly curious and interesting spectacle is presented by the young animal, perfectly formed, with its eyes, its jaws, and all its other organs readily identifiable, occupying one-third of the volume of the parent, as it lies horizontally across the blunt sac-like extremity, occasionally working its jaws, and moving its viscera to and fro by means of its muscle-threads; the double integument of the parent and offspring no more interfering with distinct vision than two thin films of glass. There is an outlet for the young at the period of birth, but it has no connection with the alimentary canal.

In some of the species not the slightest trace of a foot is

present, but in others there is a very small one, with two excessively minute toes.

Of the *habits* of the animals of this order, perhaps the most interesting examples are those afforded by two species of *Notommata—N. petromyzon* and *N. parasita,* which live—the former occasionally, the latter habitually—in the majestic rolling spheres which bear the name of *Volvox globator.* In an interesting paper by the Editor of this REVIEW, the appearance and the salient points of the history of this remarkable organism, once considered an indubitable compound animal, now by most naturalists referred to the vegetable kingdom,—are well given.* Within the beautiful green spheres of the *Volvox, N. parasita* may be frequently seen comfortably lodged, whence Ehrenberg gave it the appropriate designation of "*the Pirate.*" On examining several *Volvoces,* even with a pocket lens, we may frequently detect such as are thus tenanted by their containing one or more spots, differing from the young clusters in form and colour. Each of these spots is found to be a *Notommata,* snugly ensconced within the globe, in the spacious area of which it lives at ease, and swims to and fro like a gold-fish in a glass vase. We see it for the most part, however, clinging to the inner surface of the circumference, engaged in devouring the green monads with which its gelatinous expanse is studded, or else eating away the embryo clusters. The action of the protruded jaws of the *Notommata,* as it eagerly nibbles away at the monads, is very energetic; but its progress is not commensurate with its vehemence. I have not been able to see one actually detached and swallowed. Frequently two or more *Notommatæ* are found in the same *Volvox,* and I have seen as many as four, with an egg besides. They do not interfere with each other, but each pursues his own avocation.

It is chiefly the smaller *Volvoces* that contain the parasite, especially those which have the embryos very immature. I have not seen any *loose* in a large *Volvox;* but in embryos almost grown, and nearly ready for escape, I have several times seen a *Notommata.* If we wonder at this *Rotiferon* obtaining access to the interior of the sphere, we wonder still more at seeing even the young spheres, while yet within the mother sphere, thus tenanted, especially as the circumference both of mother and daughter appears unbroken. On careful examination, however, the parent *Volvox* shows places where the monads are interrupted; and I have thought that I could discover, in each case of a tenanted embryo, that its circumference had a ragged point.

The *Volvox* does not appear to suffer from the depredations

* "Popular Science Review," vol. i. p. 57.

of its ungrateful guest, for, though half of its young embryos may be devoured, it glides along with as swift and as majestic a course as ever; nor are the vibrations of its cilia intermitted, for any floating atoms that lie in its track are hurled away with impetuosity the moment they come within reach of this living whirlpool.

In some spheres we find eggs with *Notommatæ;* in some, eggs alone. Perhaps the parasite is always hatched in a parent *Volvox*, but the embryo globe is probably entered from without, and the *Notommata* is then expelled with it. The *Notommatæ* frequently eat their way out, and swim at freedom. Observing one, large with a nearly matured egg, in the globe of a small *Volvox*, I opened the latter with a fine needle, and freed the *Notommata*. This I placed in clear water, and added several *Volvoces* of various ages, taking care that none contained a parasite. I then watched its proceedings, to see if it would enter any one of the globes, but though in the course of its swift and headlong rotation it now and then came into contact with a globe, and would arrest its career to play over its surface, and even to nibble at it, it would presently dart away again, not entering one in the lapse of several hours. In the course of this time it deposited its egg loose in the water, which probably it would not have done had I left it to follow the dictates of its instinct.

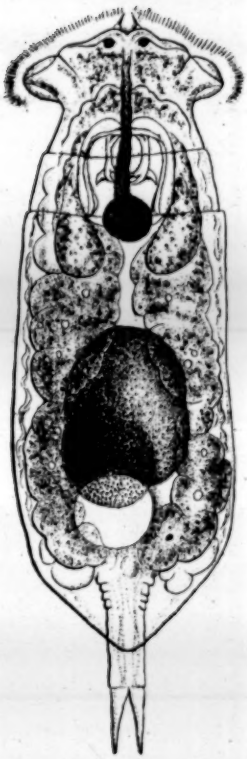
For further details of the economy of this interesting creature I must refer to a paper of my own in the Transactions of the Microscopical Society of London for 1851.

EXPLANATION OF THE ILLUSTRATIONS.

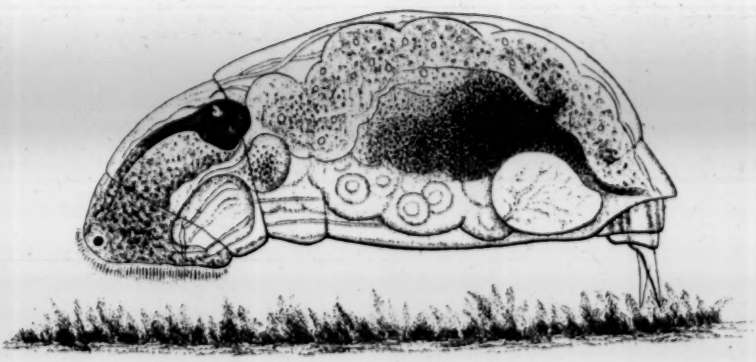
Plate XIX.—Fig. *a* represents *Eosphora aurita*, seen from the back, the ear-like lobes evolved, in the act of swimming.

„ Fig. *b* represents the same animal, seen from the side, in the position assumed in marching and feeding. Both figures are magnified about 250 diameters. From the life.

a.



b.



P.H. Gosse ad vir

W.West Lith

Eosphora aurita.

ON THE MORPHOLOGY OF VINCA MINOR (SMALL PERIWINKLE).

BY JAMES BUCKMAN, F.L.S., F.G.S., ETC., PROFESSOR OF BOTANY AND GEOLOGY.

TIME was when the collecting botanist almost avoided all specimens of plants that were not typical in form; but since the immortal Goëthe propounded his remarkable morphological views, the aberrations of form assumed by some plants under extraordinary circumstances have been carefully inquired into, and their teachings made to explain the theories of plant structure—vegetable comparative anatomy—which knowledge is the very foundation of correct and philosophical classification.

Viewed in this light, examples of plants which were once set aside as *monsters*, are now carefully studied by the philosophical botanist, and as these often occur unexpectedly, I purpose from time to time to offer the readers of the POPULAR SCIENCE REVIEW some illustrations of the more remarkable examples of morphological changes which have as yet come before me, or which may hereafter reward my search.

Now, in following out this plan no very lengthened description will be required, because even the student will at once recognise the meanings of the drawings; when, however, we have a tolerable series of cases before us, it may perhaps be well to recur to them, in illustration and elucidation of the remarkable views and generalisations such objects cannot fail to establish in the philosophic mind.

Our first specimen then is that of the *Vinca minor* (the Lesser Periwinkle). Plate XX., fig. 1, is a magnified drawing of a flower only partially expanded; in this the petals will be seen to be united into a tube, which has been opened to expose the curious columnar pistil and the five remarkable stamens. Here the style, of most elegant form, is surmounted by a stigma which is externally covered with fine bristle-like hairs, so pointing in every direction that, like a modern bristle door-mat, it is certain to sweep off whatever it may come near. Now, in the unexpanded flower the five two-lobed anthers converge over the top of this stigma; but as the flower opens, and is exposed to heat and sunlight, the anthers burst; and simultaneously

with this the column or style of the pistil elongates, and in its upward progress effectually sweeps off the liberated pollen (A 1), and thus the office of fertilization is brought about.

Figs. 2 and 3 are illustrations of a monstrous change in these simple arrangements. In these the petals have increased beyond the normal number of five, to ten; they are not united into a tube by their claws, but are separate and distinct. Of these, half are distinct petals, as fig. 4; and alternating with these, and forming an inner whorl, will be found stameniferous petals, as fig. 3*a*, and figs. 5 and 6.

In some examples of these monstrous flowers, enlarged stamens may be seen, as fig. 7; in which case the pistil is found usually more or less perfect, and the petals not wholly, but only partially free: here fertilization is possible, but there can be but little doubt that the resulting seed, on cultivation, would bring about the more complete change of form as represented in figs. 2 and 3. In this latter the pistil is abortive, consisting only of a small point representative of the style, and of course the seeds are not developed.

Illustrations of the above may be found in what is called the Double Periwinkle planted on most rockeries, and about the "wilderness," especially of our older gardens; and they may be viewed by the tyro in botany as objects of great interest, illustrating the fact that what was once called a monopetalous corolla is after all composed of five petals united at their base by cementation, whilst here the stamens may be viewed as metamorphosed petals.

EXPLANATION OF PLATE XX.

Fig. 1. An opened flower of *Vinca minor* showing the pistil just before it pushes through the stamens by elongation.
Fig. 1*a*. Pollen of ditto, 300 diameters.
Figs. 2 & 3. Metamorphosed flowers, each with ten distinct petals.
Fig. 4. A separated petal.
Figs. 5 & 6. Petaloid Stamens.
Fig. 7. A true stamen.

1

1a

2

a

3

4

7

5

6

J.E.Sowerby.sc.

W.West, imp.

Morphology of Small Periwinkle.

OUR BRITISH JUNGERMANNIÆ.

BY MARGARET PLUES.

THERE is a group among our cryptogamous plants of exceeding delicacy of structure and grace of form, which lack their due meed of observation from plant lovers. These are the Jungermanniæ, or Liverworts, constituting the main part of the family of Hepaticæ, the second section of the Calyptreæ of Mohr, divided by him from the Mosses, because of the want of an operculum or lid, the distinguishing mark in the moss group. These Jungermanniæ exhibit cellular structure to perfection. With a pocket lens you can see the transparent network of the leaves, and under the microscope they become most beautiful objects. No male organs are discovered; the seeds are extremely minute, they are mingled with elastic spiral threads, and contained in a receptacle of a round or oval form; when the seeds are ripe the receptacle bursts into four parts, and thus when empty appears as a minute brown cross. This receptacle is supported upon a foot-stalk of greater or less length, sometimes measuring but a few lines, and sometimes attaining the length of two or three inches; it is slender, colourless, and almost transparent, and resembles spun glass; the oblong cells of which it is composed appear like joints under the microscope. The stalk rises from a tubular perichætium or calyptra formed upon the stem, or frond; it varies in form, being sometimes entire at the mouth, and consisting simply of the tube, but more frequently torn and jagged, and often accompanied by sepal-like formations.

The Jungermanniæ are parted into two great divisions: those assuming a form such as we are familiar with in many sea-weeds, are called Frondosæ; and those with distinct stem and leaves, rather resembling mosses in their growth, are named Foliosæ. These latter are subdivided into Stipulatæ and ex-Stipulatæ, according to whether or no there are rudimentary leaves, or stipulæ, under the stem, accompanying the true leaves.

During the damp, mild weather of this winter and early spring, I have amused myself by the constant search for Jungermanniæ. One wood, with many paths and a pleasant name—the Chase Wood—has been my hunting ground, if I may be permitted to use a term so at variance in meaning from what it formerly signified.

Imagine, then, a dull February day, with the roads two or three inches deep in mud, and most uninviting for pedestrians, a thick fog hanging over the meandering Wye and its adjacent meadows. Turn with me to yon wooded hill; even the deep lane with high banks of red sand, where the dying fern fronds droop hopelessly, and the mosses display their most brilliant green, is less dirty than the main road. The lane leads past a quarry, and then you enter the wood. Perhaps the trees do drip a little, but only in the lower part; the path ascends by rocky steps, it is wide enough to save any danger to the looped-up dress from the long grass at its edges, and as you rise higher and higher the atmosphere becomes clearer. Red rock, cropping out here and there, retains but little of its original form, for the mosses clothe it thickly about its base, and our friends the Jungermanniæ cling upon the damp bank beneath it. We find large leaves, or more properly fronds, lapping one over another, each rooted to the wet ground; this is one of the Frondose Liverworts, *J. epiphylla* (No. 13). Out of the substance of these fronds, a little cup or calyx has arisen, presently a tubular calyptra will spring from it, then a long transparent stalk, bearing the round receptacle, which will burst into a cross of four broad valves. The fronds are dark green, shaded with brown or purple in the centre. This Liverwort is a common object, not only in our woods, but on damp garden walks, and even on flower-pots in wet places. A closely allied species, with fronds curled at the edges, and of a paler hue, flourishes about a small spring in the same wood; its large white calyptræ, and the narrow segments into which the receptacle splits, are clear marks of distinction: *J. pinguis* (No. 12). Clustering about the tree roots, and sometimes growing in patches on the lower part of the bark, you find the slender fronds of the *J. furcata* (No. 11). Its pale green hue attracts the attention, and its crowded fronds have a mossy appearance; it is only when you stoop to examine it closely that you recognize their strap shape.

Nearing the top of the wood, splendid blocks of puddingstone guard the path on either side. Here it well repays the botanist to take out his glass, and examine the plants on the southern surface. I could name half a dozen mosses, and nearly as many lichens, as well as several ferns, among those rock dwellers; but I must restrict myself to Jungermanniæ. To begin at the base, where the mosses grow thick, we find interlacing amongst them the familiar branches of the *J. Asplenoides*, the largest and most frequent of the Leafy Liverworts (No. 1). This plant is rare in fruit, but its long branches, with their outspread rows of horizontal leaves, pale green and glittering, are to be seen on every damp hedge-bank or shady copse. The slender *J. bidentata* grows under that rock

also, its foliage still paler, its stems tender in the extreme; it is slightly branched, its calyx and calyptra are large in proportion to the rest of the plant, and deeply cut; the footstalk is long and the receptacle oval. The fruit was formed, but not opened in February (No. 6). Higher up the rock, but also sheltered by mosses, flourish the minute but sturdy stems of the *J. obtusifolia* (No. 10). These stems are not branched, and stand almost upright. The leaves are divided into two rounded lobes; the smaller is turned in front of the stem, and the larger wraps round to the back, thus giving the appearance of two rows of leaves on either side the stem. The fruit springs from the end of the stems, but it does not appear till much later in the year. Ascending yet higher on the rock, to a level with your own shoulder, you find a still more minute Jungermannia covering the stone in filmy patches of pale green. This is the *J. reptans* (No. 7); it is a fairy-like plant, its main stem and plentiful branches only occupying about a quarter of an inch. The lens shows the leaves to be placed alternately on either side the stem, each cut into four sharp points. A paler film, studded with minute oval objects, which prove on examination to be calyptræ, and from which issue numerous glassy threads, bearing a forest of microscopic brown crosses, proves to be a patch of *J. connivens* (No. 3); every tiny leaf standing forth as a perfect crescent under the microscope, though the naked eye can hardly distinguish the perfect plant from an Alga, except the fructification be present.

The trees form favourite habitats for the Jungermanniæ. In the Chase Wood we find not only the *J. furcata* on the bark near the roots, but large patches of a closely interlaced Liverwort. On this mild February day the foliage is a bright green; the forked branches bear calyptræ on their summits, from whence issue very short foot-stalks bearing slightly oval receptacles; or, if these have burst, crosses of four blunt valves. This is the *J. complanata* (No. 4). Upon the same tree possibly, or failing that, on a very near neighbour, Liverwort patches of a very different hue are flourishing and displaying their seed-vessels. The overlapping leaves, with their rounded forms and unbroken margins, show an affinity with the *J. complanata;* but a marked difference will be seen on applying the lens, for beneath each leaf is a rounded stipule, proving it to belong to the Stipulatæ division of the foliaceous group. This Jungermannia spreads in wide patches, generally of a reddish hue: *J. dilatata* (No. 8).

The wood grows thicker, and we find ourselves descending between oozy banks of red earth. Here a partial greenness tempts us to a closer inspection, and we recognize tiny crosses of warm brown. We feel sure we have got a Jungermannia, but we must apply the lens before learning its form. The

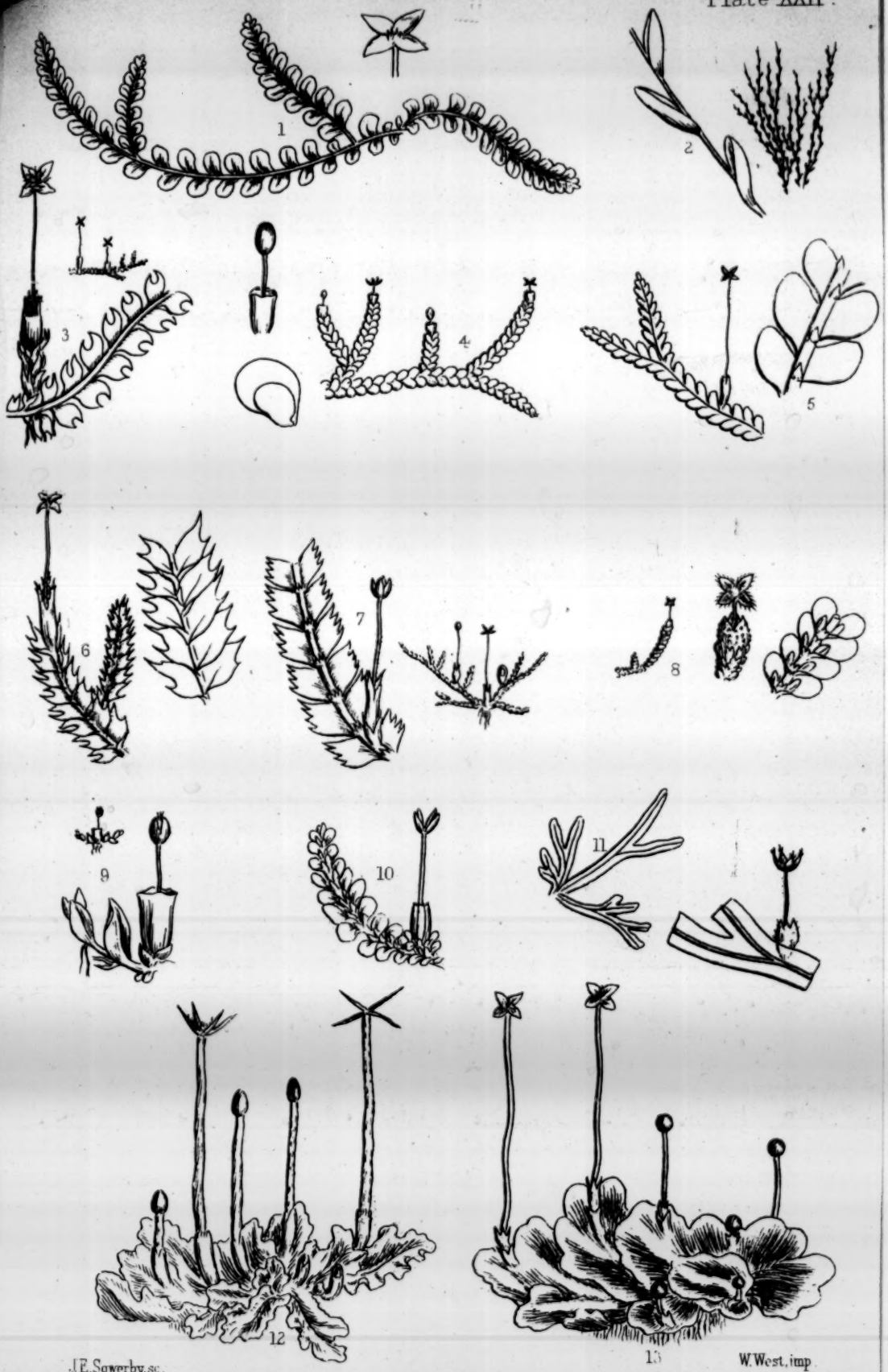
stems are short in the extreme, and bear sharp pointed leaves on either side; at its summit it carries a calyptra cup-shaped; the oval receptacle rests on a very short stalk. The colour is yellow-green, and the plants grow in a scattered fashion, not in a dense patch, as is usual with Jungermanniæ. Its turned-in leaves procure it the name of *J. calyptrifolia* (No. 9). The same bank nourishes the long straggling branches and glittering foliage of the *J. polyanthos.* On close examination we find small stipules cut into two points beneath the stem, from behind which little rootlets spring, fastening the branch at a distance of every few lines to the clay. A few weeks later and the patch will be strewn with white calyptræ, glassy footstalks, and slender crosses (No. 5). Once more rocks rise on the side of the path, but here it is the north exposure that nourishes the Liverwort. Numerous slender branches of dark green form a network, and we are inclined to pass them by as Algæ, and irrelevant to the subject of the day; even the lens fails to discover anything more than mere inequalities in the thickness of the threads. But we carry it home, plunge it in water for a few moments, and apply the microscope; and lo! the threads are rounded stems, set on either side with closely compressed leaves, clasping with their heart-shaped bases the slender stems; it is the *J. cordifolia* (No. 2). Other overhanging rocks are draped with the spreading branches of the robust *J. platyphylla,* lying one above another tile-fashion, and affording good handfuls of foliage. The colour is olive-green, varying in hue, and the fruit is rare; but no moss is commoner on the perpendicular surface of rocks than this Liverwort. Here the leaves are divided in two lobes, like those of the *J. obtusifolia,* but the smaller lobe is turned to the under side of the branch; there is a stipule also, about the size of the smaller lobe, and situated under the stem, between the rows of turned-in lobes; this gives an appearance of very close and abundant foliage to the under part of the branch. Trees growing about these rocks have occasionally a very verdant patch at their roots; the strikingly fresh green attracts the observer, and he finds the plant to be *J. serpyllifolia,* a minute Liverwort with entire leaves placed horizontally on either side the stem, and moderately branched.

Let us search the woods and hedges immediately around us, and ere a score of moist days have been thus passed, few will be dissatisfied with their sheet of Jungermanniæ.

EXPLANATION OF PLATE XXI.

Fig. 1. Jungermannia Asplenoides.—2. J. cordifolia.—3. J. connivens.—4. J. complanata.—5. J. polyanthos.—6. J. bidentata.—7. J. reptans.—8. J. dilatata.—9. J. calyptrifolia.—10. J. obtusifolia.—11. J. furcata.—12. J. pinguis.—13. J. epiphylla.

Plate XXII.



J.E.Sowerby,sc.

W.West,imp.

Jungermannia

COLOUR-BLINDNESS.

BY JABEZ HOGG, F.L.S., &C.

THE eye—that index of the soul, that channel of human knowledge—conjures up a host of feelings when the mind is directed to it, as an object of especial attention. Of the five senses with which most of us have been blest, the loss of sight seems to be the greatest calamity that can befall us. Reflect for a moment on the condition of those deprived of this exquisite gift. To what a sad state are they reduced who, in a perpetual darkness in the midst of light, have not anything like a conception of what we mean when we talk of the golden sun, the bright stars, the ever-varying tinted flowers, the beauty of spring, the glow of summer fields, the ripening fruits of autumn, and all beside that clothes the face of nature so beauteously to our eyes!

Our theme, however, is not with those who have so large a claim to our sympathies, but rather with others among us who suffer from a partial kind of blindness,—not necessarily a mechanical or optical defect, but one which is almost unknown or unrecognized by those who suffer from it, and, being ignorant of its existence themselves, cannot easily be persuaded to believe it.

An explanation of this curious defect will be worth while listening to, the more so as many eminent philosophers have suffered from it; and it is perhaps owing to this circumstance that so much time and attention has been given to the investigation of so curious an anomaly. It is well known that a ray of light, from any source, may be divided by means of a prism into a number of rays of different refrangibility, forming a series, and called a spectrum, the most familiar instance of which is the rainbow. The drops of rain falling between the sun and the eye act as so many prisms, and each ray is thereby bent or refracted to a different angle, the red most and the blue least; and as thus the rays of light are made to enter the eye separately, we have produced the beautiful prismatic phenomenon of the rainbow, the outermost colour of which is red, the innermost violet, and the intermediate, from slightly intermixing and overlapping each other, we respectively name orange, yellow, green, blue, and indigo. The three homogeneous colours—yellow, red, and blue—have been shown by

Mr. Field, in a satisfactory manner, to be in the numerical proportional power as follows :—yellow, three; red, five; and blue, eight. When these three colours are reflected from any opaque body in these proportions, white is produced; they are then said to be in an active state, but each is neutralized by the relative effect that the others have upon it. When they are absorbed, they are in a passive state, and black is the result. When transmitted through any transparent body, the effect is the same; but in the first case they are material or inherent, and in the second impalpable or transient. Colour therefore depends entirely on the reflective or refractive power of bodies, as the transmission or reflexion of sound does upon their vibratory powers. By the undulatory theory of light, philosophers account for the variously coloured rays of the solar spectrum, by calculating the differences in the frequency of the vibrations of each ray—that is, the rays of light are supposed capable of vibrating in waves of different lengths. The shortest waves produce violet light, the longest red; and with such precision have some of the more complex phenomena of light been studied, that mathematicians have absolutely been able to calculate the number of vibrations necessary to produce an impression of either white or coloured light. For instance, the periodical movements of the medium in white light regularly recur at equal intervals, five hundred millions of millions of times in a second of time; in the sensation of redness, our eyes are affected four hundred and eighty-two millions of millions of times; of yellowness, five hundred and forty-two millions of millions; of violet, seven hundred and seven millions of millions; and so on.

How seldom do the most reflecting amongst us think, as we gaze on the flowers composing a bouquet, and inhale their fragrance which perfumes the surrounding air, that in order to distinguish the yellow tint of the laburnum, five hundred and forty-two millions of millions of undulations of light must occur; that the ruby fuschia requires the eyes to receive four hundred and eighty-two millions of millions of undulations in a second; that the violet's tint is only distinguishable when seven hundred and seven millions of millions of vibrations have penetrated to the sensitive retina!

When objects are illuminated by homogeneous yellow light, the only thing which can be distinguished by the eye is the difference of intensity or brightness. It is now a generally received opinion that different bodies, according to the manner in which their minutest particles are arranged, possess the power of variously absorbing a part and reflecting the other portion of the rays of light that fall upon them; and that on the proportions of the rays absorbed and reflected does the

colour depend, and that it is not a part of the object itself. The meaning of this will be best understood by an example. When a ray of light falls on the green grass, part of the ray is absorbed and part reflected, and the grass is only seen with the part that is reflected. The green we see consists of the original white light, deprived of a portion of its rays by absorption. It is, therefore, partial darkness, and not absolute light, consequently not a pure and absolute green, but only a residual group of the unabsorbed coloured rays. A poppy appears scarlet, as it absorbs all the colours of the rays except red, and hence its peculiar tint; but if it be looked at through green glass it will appear black: as the poppy only reflects the red ray, this is absorbed by the green glass. The red of the rose, the blue of the violet, the yellow of the jonquil, are due to their absorption of all the rays excepting the red, blue, and yellow. The pale-tinted rose, almost white, reflects nearly all the coloured rays. We can, therefore, easily perceive, without light, the face of nature would be that of a world in mourning; it is light that enlivens the scene, painting the exterior with a beauty, richness, delicacy, and harmony that man vainly attempts to rival. Colour is so dependent on light, that when artificially produced, as by candle or gas, from not being pure, many things appear of a different colour, as is well known by the lady who attempts to choose a ribbon or the artist who paints a picture by artificial light: a blue being mistaken for a green, and a green for a blue. On a moonlight night we cannot distinguish the colour of a chimney-pot; and were we to take a number of pieces of cloth, or different coloured papers, and examine them by the bright light of the moon, and write on the back of each the colour it appears, we should be astonished in daylight to see how much we had been deceived as to the true tint of each.

Assuming, therefore, that the sound eye can see perfectly well three simple colours—red, yellow, and blue—and that all the rest of the colours of the spectrum are mixtures of these with each other, let us now proceed to inquire what is the peculiar condition of sight in those persons who, being unable to distinguish certain rays, are, as we have already stated, *colour-blind;* but not necessarily owing to disease of the optic nerve or retina, but simply arising from inability to recognize those rays of light which consist of pure red.

Professor Maxwell, who has closely and philosophically investigated the subject, says:—"The mathematical expression of the difference between the colour-blind and ordinary vision is, that colour to the former is a function of two independent variables, but to an ordinary eye of three; and that the relation of the two kinds of vision is not arbitrary, but

indicates the absence of determinate sensation, depending upon some undiscovered structure or organic arrangement, which forms one-third of the apparatus by which we receive sensations of colour.

"Suppose the absent structure to be that which is brought most into play when red light falls on our eyes, then to the *colour-blind* red light will be visible only so far as it affects the other two sensations, say of blue and green. It will, therefore, appear to them much less bright than to us, and will excite a sensation not distinguishable from that of a bluish-green light."

That is to say, the normal eye reduces its colour-sensations to three, and analyzes white light into three coloured elements, one of which is red; and that the colour-blind eye, on the other hand, reduces its colour-sensations to two, and analyzes white light into two elements, neither of which is *red;* for colour-blindness takes its character more from its non-recognition of red than its positive recognition of yellow and violet. An essential distinction which can thus be drawn between perfect vision and colour-blindness has induced Sir J. Herschell to adopt the term *dichromatic* (cognizant only of two colours) to characterize the colour-blind.* We shall now examine how far the withdrawal of the red ray affects other colours. In the first place, all the light tints, as well as the dark tints, are liable to be mistaken for each other. The orange is no longer red and yellow, but dark yellow; the yellow is purer, the green distinct, the blue purer, and the indigo and violet no longer red and blue, but blue mixed with more or less black, the violet being the darkest, as containing least blue in proportion to red, while the red part itself, though not seen as a colour, is not perfectly black. The red is generally seen as grey, or neutral tint; the orange as a dingy yellow; the blue as a dirty indigo, and the violet as a pale blue, mixed with black and grey.

In the "Philosophical Magazine" for 1857 and 1862 will be found a series of experiments, instituted by Professor Maxwell, to test the accuracy of his own eyes in distinguishing between shades of colour; and his data may be followed by any one curious in the same field of inquiry. A large variety of all shades and tints of coloured wools may be used for the purpose. They should be placed in a mixed heap before the person, who must try to arrange and name them, beginning with the

* Dr. Wilson employs the term *chromato-pseudopsis* (false vision of colours), as it, he says, "very fairly expresses the general character of the affection, which more frequently shows itself as an insensibility to certain colours, than as a total inability to discern them."

darkest, and putting those tints together that are most alike. Professor Maxwell adds, "The intelligent testimony of the colour-blind may supply a sure foundation for the theory of vision."

Many other curious and interesting points in connection with the philosophical part of our inquiry might be entered upon did the space at command permit us to do so; but enough has been said about light and colour to enable the reader to comprehend the more intricate part of the subject we are about to enter upon—namely, colour-blindness. As I have already said, the defect does not necessarily interfere with the integrity of the eye as an optical instrument. Indeed, in a case recorded by Dr. Wilson of a Mr. R——, an engraver, he counts himself not a sufferer, but a gainer by his colour-blindness. "Thus, an engraver has two negative colours to deal with—black and white. Now, when I look at a picture, I see it only in white and black, or light and shade; and any want of harmony in the colouring of a picture is immediately made manifest by a corresponding discord in the arrangement of the light and shade, or, as artists term it, the *effect*. I find, at times, many of my brother engravers in doubt how to translate certain colours of pictures which to me are matters of decided certainty and ease. Thus, to me it is valuable. I am totally unable to retain certain colours in my mind, nor able to give their names when shown to me a second time. Sometimes I can see some reds and greens by lamplight. A few years ago I ventured to buy some green baize; but unfortunately bought a very bright red, which was excessively painful to my eyes by lamplight, but agreeable enough by daylight. One of my brothers is equally defective, and my grandfather was very deficient in his knowledge of colours. My sight is natural, and rather powerful; for I am able to see very minute objects without assistance from glasses, and I can also see very distinctly with but little light. With regard to the rainbow, or solar spectrum, I can see clearly there are different shades of colour, but I am unable to say which is the red. The violet and yellow are very clear and distinct."

Those who have compared a coloured drawing or oil painting with an engraving of it will appreciate the nature of the difficulty which Mr. R—— so easily surmounts. In heraldic engraving, for example, a system has long been followed of representing each colour by a separate set of marks. It comes, however, to be a very curious question whether this gentleman's version of a picture would satisfy one whose perception of colours was perfect. Professor Kelland and Dr. Wilson think it would not, as they have observed in the course of their inquiry that

colour-blind persons arrange different shades of the same colour according to their intensity, in a series which did not satisfy their eyes; and further, that their arrangement of different colours according to their intensities seemed discordant to both these gentlemen.

The celebrated Dugald Stewart, and Dr. Darwin, the poet and botanist, could only by shape discover the difference between cherries and the leaves among which they grow. Dr. Dalton, the propounder of the atomic theory in chemistry, was not convinced he was colour-blind, until by accident observing the colour of the flower of the *Geranium zonale* by candlelight in the autumn of 1792. The flower was pink, but it appeared to him almost a sky-blue by day: in candlelight, however, it was astonishingly changed, not having then any blue in it, but being what he called red; forming a striking contrast to the blue. He also compared sealing-wax to one side of a laurel leaf, and a red wafer to the other, and his doctor's scarlet gown to the leaves of trees. "I have seen specimens," writes Dr. Dalton, "of crimson, claret, and mud which were very nearly alike. Crimson has a grave appearance, being the reverse of every showy or splendid colour. The colour of a florid complexion appears to me that of a dull, opaque, blackish blue upon a white ground. Diluted black ink upon white paper gives a colour much resembling that of a florid complexion. It has no resemblance to the colour of blood." From the care with which Dr. Dalton investigated his own defect, it has become popularly known as "Daltonism." Nor was his case at all peculiar with regard to flowers, for the colour-blind are constantly found unable to distinguish the petals of the scarlet geranium from its leaves, the flowers of the wild poppy from the unripe corn amongst which it is growing. Moreover, those who thus mistake scarlet, regard green as a darkish colour, and confound it with drab.

The number of cases now upon record of persons afflicted in this way are very considerable; though until within these late years it was supposed to be confined to a very few individuals. From the calculations of various authors, that *one* person out of every *fifteen* is colour-blind, and from the investigations of the late Dr. Wilson upon 1,154 persons at Edinburgh made in 1852-53, we gather that—

1 in 55 confounded *red* with *green*,
1 in 60 confounded *brown* with *green*,
1 in 46 confounded *blue* with *green*;

hence, that *one* in nearly every *eighteen* had this imperfection. Professor Siebeck found five out of forty youths in the two upper classes in a school at Berlin colour-blind. Professor

Prevost considers it occurs on an average in one out of twenty persons; and Wartmann, whose investigations almost exhaust the subject, thinks this estimate is not exaggerated. M. Lubeck rejects this conclusion as unsound, from the observations having been made in England and Germany, where blue is the prevailing colour of the eyes; and it is a question with him whether it occurs so frequently in persons the *irides*-colour of whose eyes are black or hazel. In answer to this, it seems the great majority of cases examined by Wartmann had black irides.

This consideration, however, cannot be of much importance beyond the physiological correspondence observable with the ophthalmoscope between the colour of the iris and the fundus of the eye, by the relative determination of the *pigmentum nigrum* * in persons of different complexions. In adapting the eye to varying intensities of light, the pupil (iris) of course acts a principal part as to the amount of visual rays received, but its changes cannot have much effect upon the varying intensities of the vibrations to which the supplementary phenomena of colours are ascribed. It is the intensity rather than the character of the light that the iris controls, and which remains the same whatever sensation of colour is excited. It is different with regard to the influence which sex seems to exert, for on an analysis of upwards of two hundred cases, the proportion of males affected is no less than nine-tenths of the whole. Thus, it would appear that in this respect, the perfection of vision, the ladies have greatly the advantage over the gentlemen. There is, however, an interesting account given by M. Cumer of a family of thirteen females (extending through five generations), all of whom were colour-blind. On the other hand, Dr. Bronner, of Paris, relates the case of a learned chemist, a German, whose two daughters were free from their father's defect. The children of the eldest one were likewise unaffected, whereas three sons of the youngest were all colour-blind. A grandson, also, the son of one of these latter, inherited the defect. In the "American Journal of Medical Science," 1854, another similar case is reported, where seventeen descendants, chiefly males, of the maternal grandfather all inherited colour-blindness.

The two elder sons out of a family of four suffer from this defect. The second son, now an eminent sculptor, early in life exhibited great taste in drawing and painting, but after some few years of study was obliged to relinquish the art, in

* I make no apology for introducing technical terms into this paper, since the anatomy of the eye is so well explained in a paper which appeared in the January part of the present year. See page 220.

consequence of the many blunders he committed in the combination of his reds and greens. Upon my directing his attention not long since to a very brilliant carpet, having a bright scarlet ground, with vivid green fern-leaves running over it, he said he could see no difference except in the warmth of tone of the red over the green. I have repeatedly examined his eyes with the ophthalmoscope without observing any departure from the normal condition, except a small difference in the colour of the fundus; the choroid has less blood circulating in it, and the pigment-coat is certainly much paler. But this must be taken with some modification, as the irides are brownish, scarcely hazel: in every other respect the sight is nearly normal, as may readily be surmised, from his successful career as a sculptor. An only sister, it should be mentioned, paints to perfection.

From other instances on record, it would seem that colour-blindness is frequently compensated for by the greater exactness with which distant as well as near objects may be perceived, and this, too, in a comparatively obscure light. We find in the "Glasgow Medical Journal," vol. ii., a case of the kind with some valuable remarks by the individual himself. "All objects whatever, when viewed at a distance, lose their local colouring, and assume more or less of a pale azure blue tinge, which painters term *the colour of the air:* this is interposed between myself and a distant object. No colour contrasts to me so forcibly with black as this azure blue; and as you know that the shadows of all objects are composed of black, the forms of objects which have acquired more or less of this blue tint from being distant become defined and marked by the possession of shadows which are invisible to me in the more highly coloured objects in the foreground, and which are thus left comparatively confused and shapeless masses of colour. So much is this the case with me when viewing a distant object, as to overcome the effect of perspective, and the shading in the form and the garments of human beings at some distance from my eye is often so predominant, and marks them out so distinctly, as to overcome the effect of diminution of size; and although I see the object most distinctly, I am unable to tell whether it be a child near me or a grown-up person far off."

Both Professor Wartmann and Dr. Wilson examined and tested individuals who corrected by the touch erroneous judgments which they formed regarding colours. A case of the kind came under my own observation which I shall presently relate; and I know and have met with very many instances in the totally blind able to distinguish every variety of colours by the delicacy of the sense of *touch:* they tell me there is a

sensible difference in the degree of heat conveyed to the point of the finger.*

The fact that a difference of tint is recognized, although the eye of the colour-blind person does not appreciate any difference of colour, as red and green, when compared together, and that every one is educated to call things by certain names, whether he understands the meaning or not, may help to explain the slowness with which this defect is discovered; and again, that the report of every case is rendered hopelessly imperfect from the impossibility of subjecting the eye to the test of colour.

In the "Philosophical Transactions for 1859," Mr. W. Pole, a well-known civil engineer, thus describes his own case:—"I was about eight years old when the mistaking a piece of red cloth for a green leaf betrayed the existence of some peculiarity in my ideas of colours; and as I grew older continued errors of a similar kind led my friends to suspect that my eyesight was defective; but I myself could not comprehend this, insisting that I saw colours clearly enough, and only mistook their names. I was articled to a civil engineer, and had to go through many years of practice in making drawings of the kind connected with this profession. These are frequently coloured, and I recollect often being obliged to ask in copying a drawing what colours I ought to use; but these difficulties left no permanent impression, and up to a mature age I had no suspicion that my vision was different from that of other people. I frequently made mistakes, and noticed many circumstances in regard to colours which temporarily perplexed me. I recollect in particular having wondered why the beautiful rose light of sunset on the Alps, which threw my friends into raptures, seemed all a delusion to me. I still, however, adhered to my first opinion, that I was only at fault in regard to the names of colours, and not as to the ideas of them; and this opinion was strengthened by observing that the persons who were attempting to point out my mistakes often disputed among themselves as to what certain hues of colour ought to be called." At length Mr. Pole when about thirty years of age committed a glaring blunder, and this circumstance led him to make an investigation of his case, which ended in his discovering that he was colour-blind.

All who have investigated the subject of colour-blindness

* Professor Tyndall enters fully into all these matters in his work on "Heat as a Mode of Motion" (reviewed in the present number). The eighth chapter treats of the relations of light, heat, and colour, and will be found deeply interesting to those who have read this article, and desire further information on the subject.—Ed.

agree that in the greatest number of cases it is not a disease, but rather a remarkable type of vision. It is known, however, that the peculiarity exists sometimes as a matter of degree, and that an abnormal sensation of colour may be received, but of so short a duration and corrected spontaneously as to be a source of little inconvenience, and even passes unnoticed. But as many important facts in connection with the subject have come to light, it is now made essential, and very properly so, for every driver or guard of the railway train to pass an examination as to his power of perceiving and distinguishing different coloured signals used on railways. Dr. Wilson goes further, and says: "It admits of a question whether the demands of public safety would be best met by excluding colour from railway and ship signals, or by excluding the colour-blind from the office of signalmen." Red and green lamps are employed as signals at sea, as well as on railways, and many appalling accidents, no doubt, have been occasioned by mistaking the colour exhibited both on sea and land.

A mistake in colour may arise from the fact that the sensation can only be prolonged for a very *limited time*. Thus, whenever any one looks fixedly at a bright object placed on a surface of a dark tint, and then closes his eyes, or transfers them suddenly to another ground of a lighter colour, he immediately perceives an image presenting a colour complementary to the one last observed. This arises, also, when the eyes have been fatigued by the prolonged observation of a coloured and very bright object, as a coloured light, and then suddenly turned to look at another object of a different colour; or when the eyes are fatigued by overwork and hours of watching. Many remarkable cases are on record where coloured vision has been suddenly produced. The particulars of a somewhat remarkable case lately excited some attention, and a medico-legal question of importance was raised. The sufferer, a corn-dealer, brought an action against a railway company for compensation, inasmuch as that after the accident every thing appeared yellow, and all qualities of flour, therefore, were alike in colour. The evidence chiefly depended upon the man's own statement, as it appeared the eyes were carefully examined, and yet none of the medical witnesses could give any explanation as to the cause of the yellow vision. The jury, however, awarded £1,200 damages; and as a certain amount of coloured vision is not unfrequently found to be associated with paralysis, it is not difficult to believe the retina may have been partially paralysed by the severe shock received in this railway collision.

But whether we regard colour-blindness as only a curious physical phenomenon, simply a defect, or as a positively

abnormal condition in some one or more of the structures of the eye, it may be truly said we know so little concerning its true nature, that I need offer no apology for the few remarks I am about to add upon it. As I have often met with it associated with actual disease, and since by the invention of the ophthalmoscope we are now enabled to observe many very curious changes in the internal eye before unrecognized, it is not improbable by its aid we may ultimately discover some structural differences in the eyes of the colour-blind. And if the proposition be well founded that the colour of the internal membranes of the eye must affect its perception of colours, then the choroid, which is the most fully coloured of the tunics, and the one most liable to vary in extent and depth of coloration, must have a very important influence on colour-vision. Now, in the few cases that I have had the opportunity of examining, I noticed a considerable difference both in the quantity of pigmental colouring matter, in the size of the vessels, and in the amount of blood circulating in the eye. This will be seen by any one not conversant with these matters, upon comparing the size, and perfection of the vessels in the otherwise sound eye represented in figure 1 with that of figure 2, a drawing made from an eye in a state of disease, the person having also been colour-blind prior to the loss of sight. This, however, I am ready to admit, may prove to be the exceptional and not the general condition of the eyes in the colour-blind; further investigations alone will settle this point. The seat or cause of the defect probably lies altogether beyond our reach; but whatever we can learn concerning it is certain to be of service in determining the extent to which we may hope to cure or alleviate this affection of sight.

The first case of colour-blindness that fell under my notice was that of my late talented friend, Mr. Angus Reach, whose untimely death has been so much and so justly lamented. He was incapable of distinguishing green, and only partially so red. With him both were nearly the same. The former would sometimes appear more of a pink than even red. He had altogether but a very poor conception of the primary colours. This I detected on one occasion when endeavouring to demonstrate the gradation of beautiful colours displayed by some objects made to depolarize light when placed on the stage of my microscope. After a long endeavour to convince him of the fact, as he could see nothing wonderful in it, I discovered that he was unable to name the colours correctly; and he then told me he had always been indifferent about them. To prevent error he had been accustomed always to avoid describing them, except in relatively as light and shadow, or black and white. He remarked of the *vin-ordinaire* of France, that

to him it appeared so like ink that he once found himself endeavouring to write with it. He saw no red in it.

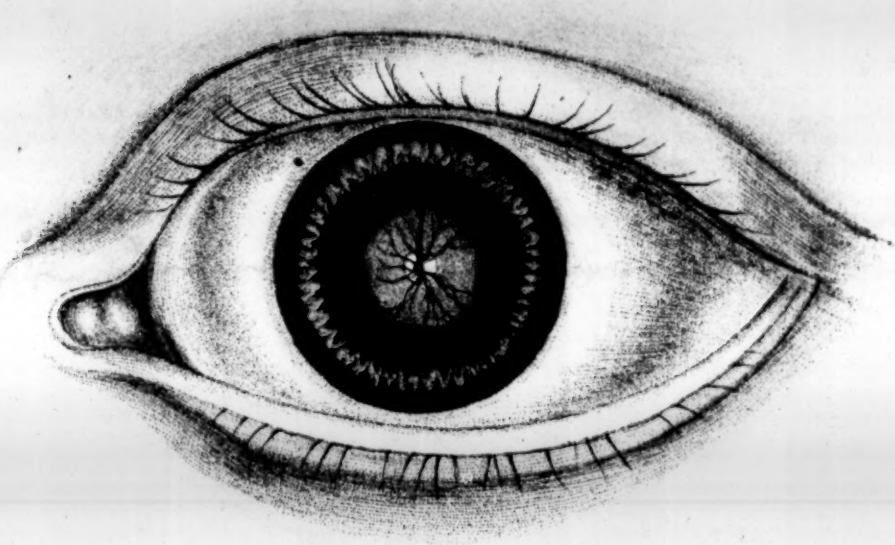
At this time, unfortunately, my attention was not so much drawn to ophthalmic disease as it has been since, and I omitted to make such an investigation of this remarkable affection which in one so fully capable of affording accurate information as to the phenomena observed would have been so valuable. Very soon after he was attacked with the first symptoms of softening of the brain, which gradually progressed during the two years his life was prolonged.

It has since several times occurred to me that the defective condition of sight might have been connected with the early development of the disease in the brain. The extreme condition of colour-blindness in which I found Mr. Reach's eyes must have been a progressive aggravation, for otherwise it is most probable more notice would have been taken of it than seems to have been the case. Indeed it might have been induced as the first symptom of an overworked brain, as I have had opportunities since of observing instances of colour-blindness arising from general disturbance of the system, and disappearing as this was corrected and relieved.

In another case, the fundus of the eyes upon examination were seen to be very pale; the defect gradually yielded to proper treatment. The gentleman, Mr. Raith, first noticed many peculiar appearances when looking at green leaves, chiefly so if growing with grass; then all appeared elongated and serrated. Even the leaves of trees—a willow-tree in particular—were not only indistinctly seen, but were very much serrated. Red flowers of most kinds could only be distinguished by their form from leaves; the exception to this was when they were globular in their form, as the dahlia.

Mr. W. Butcher was early put to the carpet trade, and after a short time he discovered some defect of sight which ultimately proved to be colour-blindness. By close observation he made himself well acquainted with the proper names of colours, and so kept his defect from those about him. By educating the eye to the peculiar *warmth* imparted when all the colours in carpets were said to harmonize, he was enabled to raise himself to the position of a salesman in a large house of business, and ultimately became travelling salesman. He has four brothers living, all of whom are colour-blind. Taking up the prismatic colours, he could distinctly see the line of demarcation between them, but confounded purple and crimson, pink and blue, red and green; and on placing before him a series of reds, scarlets, greens, and browns, he said, "They are all a mass of confusion, and it is totally impossible for me to distinguish one from the

1



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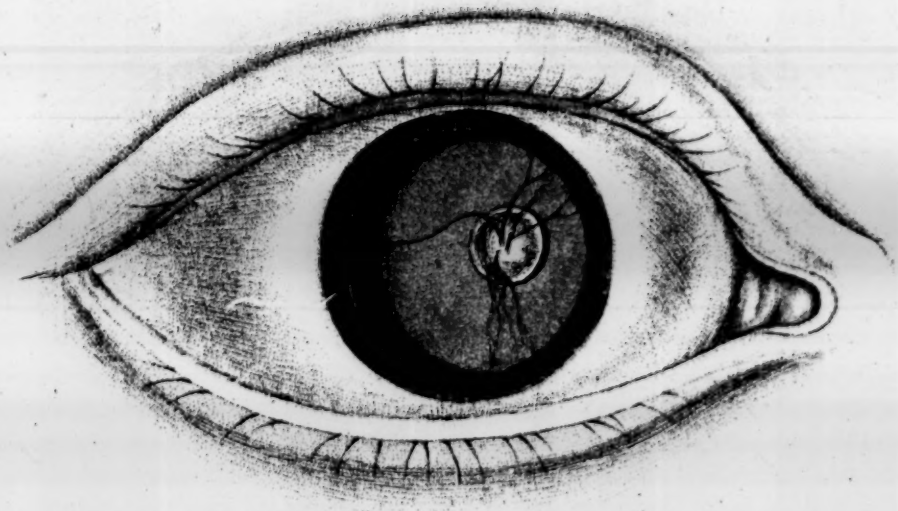

Ophthalmoscopic appearances of the Eye.

other." Orange and yellow were selected easily, and appeared very bright to him.

About six years since, whilst in good bodily health and vigour, his sight began to decline, and now, for some months past, he has been quite blind. The present appearance of the internal eye when examined with the ophthalmoscope is shown in figure 2. It is technically called *white atrophy*—that is, the blood supply to the optic nerve and retina is in some way cut off: in consequence the vessels are very small and nearly obliterated; the choroid coat is sharing the general disorganization.

These are only a few of the facts which have been brought to our knowledge in connection with the very interesting subject of *colour-blindness*.

EXPLANATION OF PLATE.

Fig. 1. An enlarged view of the colour-blind eye free from other defect. The outer dark-coloured ring is the iris. On looking through the pupil, the circular opening in the iris, with the opthalmoscope, we first see a bright pink background, the choroid coat ; this with the optic nerve constitutes the *fundus oculi*. The small and nearly centrally *situated* circular disc observed when the eye is turned a little inwards, is the optic nerve, and from its centre issues the vessels of the retina. Artery and veins closely accompany each other for a short distance, and then divide, first into two branches, one of which, with its vein, is seen to proceed upwards, and another pair downwards ; and after passing the margin of the optic nerve they diverge, and again subdivide, split up into numerous smaller branches, some of which come forward to the ciliary processes. The vascular choroid coat imparts the pink colour to the back of the eye, which is nearly all reflected to the eye of the observer. The only difference observed in the eye of the colour-blind is the paler appearance of the fundus, or choroid coat, and occasionally whitish interspaces indicative of a small and languid blood supply.

Fig. 2. Shows the internal eye in an advanced state of disease, and is drawn from the eye of Mr. Butcher, who, it will be noticed, suffered from colour-blindness years before his disease deprived him of sight. It cannot, therefore, be supposed that his colour-blindness was in any way owing to the disease which destroyed vision. The pupil is nearly fully dilated, forming a part of the diseased condition ; consequently, a much narrower ring of iris is seen than is given in Fig. 1. The *fundus oculi*, choroid coat, is very deficient in blood, which gives the mottled appearance, and indicates a state termed atrophy, in which the optic nerve and vessels of the retina is seen to share the supply of blood to retina and choroid, being in some way impeded, or nearly cut off, probably by a tumour forming in the brain in close proximity to the optic nerves. In other respects, the gentleman was in good health, and it is impossible at present to say to what he can attribute his total loss of sight.

REVIEWS.

THE PHYSICAL GEOLOGY AND GEOGRAPHY OF GREAT BRITAIN.*

GEOLOGY is as yet an infant science, but nevertheless an infant of prodigious size. From a few tangible and undoubted facts, geologists have been able to deduce as it were a great scheme, the history of the world's life. It consists, no doubt, in great part, of speculations and theories, many of which, in the advance of science, may prove false; but by continual observation and unwearied perseverance we are gradually arriving at the truth.

Scarce fifty years have passed since William Smith, "the father of geology," laid the basis on which all modern discoveries have been founded, and what was once considered a useless and "dry" study, now interests not only the learned in science, but all classes of society, who are eager to obtain some knowledge of the structure and nature of the world they inhabit. The Government has for two or three years past—with great credit to itself—encouraged a taste for science among the working classes, by evening lectures from the professors in Jermyn Street, and the crowded benches of the lecture-hall show how well their efforts have been directed. A course of six lectures on the physical geology of Great Britain, lately delivered to working men by Professor Ramsay, and ably reported by Mr. Mays, is now before us. The subject is treated in a manner at once interesting, instructive, and worthy of the President of the Geological Society. The way in which the connection between the scenery and geography with the geology of our island is shown, forms one of the chief merits of Professor Ramsay's course. Those who have listened to the course, or read the report, cannot fail to find a new interest in the country around them. Go they to the mountains of Wales, the Highlands of Scotland, the downs of the English south coast, or the plains of East Anglia,—all have a fresh beauty; each valley tells its tale of denudation by some roaring sea, or elsewhere by a mountain torrent; here is evidence of a mighty iceberg, there the course of a great river. A pleasure before unknown is now found in climbing the hills of Worcestershire, or the noble pass of Llanberis; for Professor Ramsay tells us something about each, as he opens to our view the waves that long since surged on Malvern's sides, and the glaciers slowly grinding out their road among the mountains

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* "The Physical Geology and Geography of Great Britain." A Course of Six Lectures delivered to Working Men in the Museum of Practical Geology, Jermyn Street, by Professor A. C. RAMSAY, President of the Geological Society. London: Stanford.

of Wales, leaving as their sole memento in these warmer days, the charming lakes and torrents so well known to the lovers of Cambria. Before, however, proceeding to these generalities, a lecture is devoted to the explanation of the nature of the two great classes of rocks, the Igneous and Aqueous, with the sub-class of Metamorphic rocks, which were changed after deposition by the sudden heat of liquid lava. The nature of denudation is also explained, and, in illustration of the enormous power of running water, Professor Ramsay alludes to the Niagara falls; thus, "denudation" in the geological sense of the word means the stripping away of rocks from the surface by some agent, so as to expose other rocks beneath. Now, water running over the surface, wears away the ground over which it passes, and carries away detrital matter, such as pebbles, sand, and mud; and if this goes on long enough, there is no reason why any amount of matter should not in time be removed. For instance, we have a notable case in North America of a very considerable result from denudation now being effected by the river Niagara, where, at the Falls, the river has cut a deep channel through the rocks about seven miles in length. The proofs are perfect that the Falls were once at the escarpment, which is at the lower end of what is now this long gorge; that the river, falling over this ancient escarpment, by degrees wore for itself a channel backwards and backwards, about a hundred and sixty feet deep, through upper strata that form a great plateau.

Probable calculations show, that to form this gorge a period of something "like ten thousand years has been employed." The manner in which deposits of mud, clay, limestone, &c., have been formed, is carefully described. As an example of the immense amount of mineral matter which water may carry in solution from rocks, the springs near Bath are mentioned, which yield 181,440 gallons of water per day, holding in solution 3402 lbs. of salts, equal to 420 tons per year; a quantity sufficient, if compressed and solidified, to form a column 9 feet in diameter and 140 feet high. Rivers, too, contain exceedingly large quantities of mineral matters; the Thames at Teddington carrying along in its waters an amount equal to 33,497 tons per annum. The second lecture is devoted to the geology of Scotland, the various phenomena of metamorphism, and the nature of the igneous rocks. The various strata forming the surface of England and Wales, and their peculiarities of structure, form the subject of the third lecture. A very interesting ideal section is given, from Wales through Gloucestershire to the Eocene beds of Hampshire; and the bearing of the geological structure of the country along the line of section upon its scenery is described: the clays forming plains; the limestone, hills with escarpments suddenly rising from the flat surface below, their faces being washed away by the geologist's giant "denudation."

Perhaps the most interesting lecture in the series is that in which Professor Ramsay describes, according to a view which he has lately advanced, the origin of the Scotch and Welsh lakes. For this purpose he takes us first to Switzerland. Here he shows us the snow-capped Alps, with their valleys each containing a great glacier. The glaciers are formed by the compression of snow, which accumulates in enormous masses on the mountain sides. Fresh ice is thus continually formed and

added to the mass behind, so that the glacier moves slowly down the valley, grinding out its bed, and constantly replenished from behind. Rocks and stones of all sizes continually fall from the neighbouring peaks on to the surface of the glacier, many slip into the abundant fissures, and thus get under the huge mass of ice, which, as it slides along, scores and scratches them, and also causes them to scratch the rock which forms the glacier-bed. When the glacier reaches a lower level it melts, and consequently deposits its freight of stones. As the glaciers are persistent, large heaps of stones are thus formed, which glaciologists term "terminal moraines." In consequence of the increase of temperature, the glacier at its lower extremity is much thinner, and wears away less rock than it does nearer its source; and thus a curved basin is formed, in which the glacier terminates. Now Professor Ramsay shows us that the great lakes of Switzerland are all situated in such basins as these, formed by great glaciers whose beds can be traced up the mountain valleys, which existed when the North of Europe was in a much colder condition than at present. In the same way he demonstrates to us that many of our Welsh and Scotch lakes have been similarly formed; for in the mountain valleys of Scotland and Wales we find the scratched stones, the furrowed rocks, and the "moraines," which are undoubted evidence of the existence, in these valleys, of glaciers. At the extremities of these valleys are the lakes, for the existence of which Professor Ramsay thus accounts. He does not, however, tell us how the trout got into these lakes, as it does not come under this branch of science; but the question is one of some interest, and is, we believe, rather a knotty point for Darwinians to work out. The Drift period, in which our island was covered with an ice-bound sea, is fully discussed in another lecture, and the well-known bone-caves and their fierce inhabitants are described. The silts and gravels of river valleys, and the flint hatchets of the Somme deposits, occupy a part of the lecture. We are sorry M. de Perthes' fossil jaw was not brought to light in time for Professor Ramsay's course, otherwise we might have had his opinion as to its claim to belong to a "real fossil man."

In his last lecture Professor Ramsay points out the influence which the geological structure of Britain has had upon its population, its manufactures, and general welfare. He shows how the mountainous parts of our country have formed a refuge for the ancient conquered tribes of Britain; how the coal-fields have centered around them an active and thriving population, engaged in manufacturing pursuits; and how the irregular contour of our coast has given rise to our great seaport towns. As to how and when man came to this part of the world, Professor Ramsay says: "We know that these islands of ours have been frequently united to the continent, and as frequently disunited, partly by elevations and depressions of the land, and to a great extent also by denudations. When the earliest human population reached their plains, they were probably united to the continent. Such is the deliberate opinion of some of our best geologists." He is able, in conclusion, to rejoice as a true philosopher over our present condition as an island: "We are happy, in my opinion, above all things in this, that by denudation we have been dissevered from the continent of Europe; for thus it happens that, uninfluenced by the

immediate contact of hostile countries, and almost unbiassed by the influence of peoples of foreign blood, during the long course of years in which our country has never seen the foot of an invader, we have been enabled so to develope our own ideas of right and wrong, of political freedom and of political morality, that we now stand here, the freest country on the face of the globe, enjoying our privileges under the strongest and freest Government in the living world."

From the extracts we have given, it will be seen that the volume is replete with information and sound science. To the beginner it will be invaluable, to the adept it cannot but be of the utmost interest. It is, without exception, the most complete, accurate, and interesting little work on British geology that has come under our notice.

THE APE-ORIGIN OF MAN AND THE NEW PHILOSOPHY.*

DO any of our readers desire to become versed in the natural history of the man-like apes, from one or the other of which they are supposed by Professor Huxley and his school to be descended? to know what features in their human organization, or what phases in their development, have led transmutationists to proclaim their simian descent; or, generally, to become conversant with the phenomena of animal development, and with the evidences of man's great antiquity? Then we would recommend them to seek this information in the work under review, where they will find all these matters ably and concisely treated, and from which they cannot fail to learn much that will be new and interesting to them.

Are there any, again, to whom such knowledge would be rendered more acceptable by the accompaniment of a "slashing" attack upon our leading English naturalist, Professor Owen, whose opinions on some of the matters referred to are at variance with those of the author and his disciples; an attack made with weapons tipped, now and then, with a little sharp personality: have they a leaning towards extreme views in philosophy; or would they hail with pleasure the introduction of "sensation" writing into matters of dry scientific inquiry? Then we know of no better source from whence they may take a long deep draught than from the volume before us.

The object of the work appears to be twofold; first, to show that the differences between man and the higher apes are not sufficiently great to entitle the former to a distinct sub-class in the animal kingdom, but that he constitutes the highest family of the order Primates, in which the apes, &c. are included; and secondly, to enunciate the author's reasons for holding that man is a modification, by "natural selection," of some lower animal, probably a species of ape; and generally to expound the new philosophy which the author believes to be inaugurated through the publication of the Darwinian version of the transmutation theory.

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* "Evidence as to Man's Place in Nature." By T. H. Huxley, F.R.S. Williams & Norgate.

As to the first inquiry, the evidence contained in the work serves to show that the attempt to raise man too high, zoologically, is unwise; for that an examination of his *structure*, compared with that of the apes, reveals many marks of family resemblance. But as the terms "family," "order," "group," &c. are somewhat arbitrary (especially coming from a transmutationist), and as it is almost impossible to find two naturalists who can agree on the subject; one claiming for man a distinct kingdom by virtue of his psychical faculties, another denying him even an ordinal distinction, on the ground of his structural resemblances to the apes, and a whole file of zoologists standing intermediate between these two extremes;—we think our readers will agree with us that this should be a mere technical debate, and that it contains nothing calculated to provoke a popular controversy.

We quite agree with the author, that it is very absurd to "base man's dignity on his great toe, or to insinuate that we are lost if an ape has a hippocampus minor;" and we go with him to the very fullest extent in his views concerning the nobility of man (perhaps a little further), believing with him that "the unity of origin of man and brutes," *if it were proved*, would by no means "involve the brutalisation and degradation of the former." But who that lays claim to authority in these matters has ever made such assertions?

If Professor Owen had based man's dignity and salvation upon such trifling features in his anatomy (and we know of no one else to whom these remarks can be intended to apply), we should have been ready to applaud the author's attacks upon that naturalist, oft-repeated though they be, not only in this volume, but wherever readers or an audience can be found to whom such a controversy is deemed interesting. But we have never been able to extract from Professor Owen's publications or addresses (and we have read and heard several) any such inference; and when the author declares the question of the "posterior lobe, the posterior cornu, and the hippocampus minor," to be one affecting his own veracity, and time after time, even after he has declared that it is positively his last performance in that part, renews his onslaught on his illustrious contemporary, he must not be surprised if a discerning public begins at length to think that he resembles the valiant Irishman—who, returning from Donnybrook fair, disappointed of his scrimmage (or encouraged by it, we forget which), politely requested some one to tread upon his coat-tail,—that he is designedly bringing giants into existence in order that he may exhibit his valour in slaying them.

No; it is not Professor Owen who misapplies the structural resemblances and differences between man and the apes; but it is our author who does so. It is he who, ignoring man's *highest* mental distinctions, falls back upon his anatomy, and upon minor features in his organisation—nominally for the "ascertainment of the place which man occupies in Nature, and his relation to the universe of things;" but really in the endeavour to prove a pet theory, which may or may not be a correct one. As our readers are no doubt well aware, the author is a warm advocate of the theory of "natural selection;" indeed, in the opinion of some, he out-

Darwins Darwin. In another work* he says of Mr. Darwin's theory, that "the argument which applies to the improvement of the horse from an earlier stock, or of ape from ape, applies to the improvement of man from some simpler and lower stock than man;" for "it is perfectly demonstrable that the structural differences which separate man from the apes, are not greater than those which separate some apes from others."

In other words he says, that if the various species of animals be the result of a progressive development from one another, by the Darwinian process of "natural selection," he sees no reason why man should be exempted from the operation of this law; for in his bodily structure he is as nearly allied to his humbler fellows as they are to one another. And as regards the *mental* distinction between the two (man and ape), our author gets over the difficulty by making the broad assertion that "there is *no* faculty whatever that is not capable of improvement;" that "every faculty being *dependent upon structure* is varied and improved, with a variation and improvement in structure;" and that "the attempt to draw a psychical distinction" (between man and the animals immediately below him in the scale) "is equally futile," for that "even the *highest* faculties of feeling and of intellect begin to germinate in the lower forms of life."

Let us now, for the purpose of dispassionate inquiry into its validity, put the author's doctrine as follows:—

Mr. Darwin believes in the origin of species by "natural selection."

With a certain reservation, Mr. Huxley believes the same; he considers it "the only hypothesis regarding the origin of species of animals in general which has any scientific existence"† and as such he does not hesitate to apply it to the origin of our race, inasmuch as the structural differences between man and ape are no greater than between one ape and another; and there is no distinct line of demarcation in man's mental constitution, as compared with the animals which precede him.

Remembering, then, that we have so far *no proof that one species of ape is derived from another*, and that we are not now considering the question of man's place in the zoological system—that is to say, that we are not prosecuting our inquiries for the purpose of ascertaining whether the structural differences between him and the apes are sufficient to entitle him to the zoological distinction of a kingdom, class, order, or what not—we will now consider the conclusions at which the author has arrived in the present volume concerning the two forms of life, man and ape, and our readers shall judge whether or not they are favourable to his own doctrine.

Let us take his summing up of the evidence, first as regards the general resemblance between the two forms:—

"In the general proportions of the body and limbs there is a remarkable difference between the gorilla and man, which at once strikes the eye. The gorilla's brain-case is smaller, its trunk larger, its limbs shorter, its upper limbs longer in proportion than those of man."‡

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* On our Knowledge of the Causes of the Phenomena of Organic Nature. Hardwicke.

† "Evidence as to Man's Place in Nature," p. 106.

‡ *Ibid.* p. 71.

Passing over that important feature, the naked skin, to which the author does not seem to think it necessary to refer, but which has done at least as much as his speech to bring into play his highest intellectual faculties, we now inquire what he has to say in regard to the extent of the difference in the capacity of the brain-cases.

"The *lowest* man's skull has twice the capacity of that of the *highest* gorilla."* This, he tells us, loses much of its systematic value when viewed by the light of certain other facts; but as we are not presuming to decide between Professor Owen and our author concerning the classificatory value of certain features, this supplement does not affect our inquiry; and we now proceed to seek information concerning the contents of the brain-cases—the human and simian brains; and we find that "it may be safely said that an average European child of four years old has a brain twice as large as that of an adult gorilla."

Coupled with the psychical differences between the two, this is rather adverse to the transmutation theory. But we must not be hasty in our conclusions; and passing over many such trifling distinctions as a tooth, "which projects like a tusk," we will try to find a brief general conclusion as to the differences between Homo and Troglodytes. And this is frankly and clearly given—in self-defence, by the way,—for the author tells us that "those who endeavour to teach what nature so clearly shows us in the matter are liable to have their opinions misrepresented and their phraseology garbled, until they seem to say that the structural differences between man and even the highest apes are small and insignificant."

No one can, however, thus misrepresent the author in this instance who says that "every bone of the gorilla bears marks by which it might be distinguished from a corresponding bone in man; *and that in the present creation, at any rate, no intermediate link bridges over the gap between Homo and Troglodytes.*"†

We place the utmost reliance upon Professor Huxley's testimony, for, as every one knows, he is a careful and conscientious observer and a comparative anatomist of the highest order. But this testimony compels us to ask: If the differences between them be so vast, and there is no intermediate link in the *present* creation, upon what does he base his belief in man's simian descent—Is the link to be found in the records of the past? And at the conclusion of his volume we find an explicit reply to our inquiry. It is "that the fossil remains of man hitherto discovered do not seem to take us *appreciably nearer* to that lower pithecoid form, by the modification of which he has probably become what he is;"‡ and if such a link exists, he intimates that it will probably have to be revealed by some "unborn palæontologist."

In this work, then, the evidences of the "probable" modification of man from the ape would appear to be that the structural differences between the two are enormously great, and that neither in the present creation, nor in the records of the past, do we find a link which brings the

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* Evidence as to Man's Place in Nature, p. 77.
† *Ibid.* p. 104. ‡ *Ibid.* p. 159.

two appreciably nearer to one another! Upon what, then, *does* Professor Huxley found his belief in our "probable" descent from the apes?—and although we give him the benefit of his own word "probable," it is a probability conveyed to the world in such terms as to admit of little doubt that in the author's mind it is a conviction.

His theory is based upon another that is *probable*—namely, that of Darwin,—a theory which the originator does not see his way clear to apply to man; although, as Professor Huxley very properly remarks, "if Darwin's views are sound, they apply as much to man as to the lower animals." Nevertheless, Mr. Darwin is discreet, and "has said nothing about man in his book."*

But our author *does* apply Darwin's theory to man, for he accepts it as proved, subject to the production of a new species by artificial selection, which will render the same process by natural selection *probable*. As we have already stated,† the production of a new species by artificial selection has not yet been attained, although in the experiments made with this object, a hundred and fifty new *varieties* have been derived from one original stock.

If any of our readers, then, will take the trouble to compare the author's two works which we have been reviewing, they will find his argument on the ape-origin of man to run thus. In the first:—‡

"New and marked *varieties* may be produced by artificial selection. Artificial selection occurs in nature, and it looks very much as though all species had been produced in the same way, for their existence cannot be otherwise accounted for. This being the only rational theory, I accept it, subject to the production of an *artificial* species."

Then, in the work before us:—

"I will now show you that the differences between apes and men are no greater than between apes and apes; that they therefore come within the range of Darwin's law, and that one is probably a modification of the other by transmutation. The differences between apes and men are enormous, and neither in the present, nor in the records of the past history of nature do we find any intermediate form to bridge over the gap between them; but according to Darwin's theory, which I have accepted, subject to the artificial production of a new species (which will satisfy me that all species are the result of 'natural selection') man is probably descended from the ape; and probably some unborn palæontologist will discover the missing link." §

This, Professor Huxley, "may be truth, but it is not evidence."

We would not for a moment deny that Mr. Darwin's theory of transmutation by natural selection is deserving of all the attention that has been, or can be bestowed upon it by naturalists; and that whether the *law* be partially

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* Lectures to Working Men, p. 153.
† Popular Science Review, No. VII. p. 392.
‡ Lectures to Working Men.
§ Of course these inverted commas do not denote that we are using the author's words.

or wholly true, or whether it be false, its author has already contributed a noble chapter to the history of nature. So *may* our author's views in regard to man's simian descent prove to be correct, but at present his reasoning on the subject can only be compared to that of the servant-maid, who was asked by her mistress why she had placed the oysters out in the yard to be eaten by the cats? Her reply was that there were no cats about; and when her mistress inquired how she knew that, her ready response was, "because, if there had been any cats about, she would not have put out the oysters." The author may imagine that we quote this anecdote in a satirical vein; but it is not so. It occurred to us as an apt illustration in common life (and he has advised his pupils thus to test such arguments) of the substitution of intuitive impressions for calm and unprejudiced investigation.

Such reasoning may be expected from those who are unaccustomed to dispassionate inquiry, but we do not expect to meet with it in such works as this.

And the author does not content himself with applying Mr. Darwin's theory to the ape-origin of man. He speaks of new "systems of theology or philosophy," propounded from time to time by men of genius, leaving his readers in doubt as to whether they must include Darwin's theory in the first or second system. Whether or not Professor Huxley lays claim to the authorship of a new doctrine, he certainly propounds one which partakes of the character both of a neosophy and of a neology; and although we find it somewhat difficult to make out exactly what are his dogmas, we shall endeavour to put them into a shape "convenient for common purposes," as he has done those of Mr. Darwin—with this difference, that we shall adhere as closely as possible to our author's own words, and let them speak for themselves. From his two recent works we thus extract the substance of his teachings:—

On the Universe in general.

All the phenomena of the universe have been produced alone by "what are termed secondary causes."*

1st. *On Organic Nature.*—The first creation of organic matter is a mystery which man is unable to solve, owing to the finite and restricted character of his faculties.†

2nd. Organic matter was created with certain properties, known as atavism and variability; the first being a tendency in the parental organisms to reproduce themselves in all their features;‡ the second a tendency in the offspring to vary from the original stock. And the interaction of these properties of organic matter, with all the conditions of existence, vital and physical, which affect organized forms, has caused all the phenomena of organic nature.§

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* "Evidences," p. 108.
† Lectures, p. 135.
‡ Lectures. Compare p. 89, l. 9 10; and 21, &c.
§ Lectures, p. 137.

3rd. From the foregoing general laws, it is obvious that every species of organized being is a transmutation of some previously existing species; and there is no absolute structural line of demarcation between any group and any other, all being connected together by some transitional link.*

Of Matter and Mind generally.—All forces, vital and physical, of mind or matter, are "co-ordinated terms of nature's great progression from the formless to the formed, from the inorganic to the organic, from blind force, to conscious intellect and will." †

Of Sensation and Intellect.—What has been stated of the physical transmutation of the animal races applies also to their psychical or mental qualities; and "even the highest faculties of feeling and intellect begin to germinate in lower forms of life." ‡

On Man.

1st. Man is probably an improvement of some simpler and lower animal form §—probably of one of the apes.

2nd. There is a vast gulf between civilized man and the brutes. In the present creation there is no link to connect Homo and Troglodytes; and if ever there has been such a link, it remains to be discovered by posterity.‖

3rd. There is no absolute psychical or mental distinction between man and the animals immediately below him in the scale.¶

4th. *Man is "the only consciously intelligent denizen of this world."* **

5th. *It is the faculty of intelligible and rational speech, which he alone possesses* (and the experience he has thereby accumulated) that has placed him in this high position amongst animals.††

6th. The experience which he accumulates during "the secular period of his existence," through the instrumentality of his speech and an occasional ray, which he thereby reflects from "the infinite source of truth," have transfigured him from his grosser nature and placed him in his high position. ‡‡

Some of our readers will, no doubt, be very much astonished at these doctrines; and we confess that we are the same; but it is not our

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* Compare Lectures, p. 143, last par.; p. 153, 2nd par.; and "Evidences," p. 109, last par.

† "Evidences," p. 108. ‡ *Ibid*, p. 109.

§ We say "probably," that we may not be accused of exaggerating the author's views; but a reference to p. 109, par. 2, will, we think, cause our readers to say we might safely have omitted the word.

‖ "Evidences," p. 104, par. 1; p. 110, par. 1; and p. 159.

¶ *Ibid.* p. 109, par. 4. ** *Ibid.* p. 110, par. 1.

†† "Evidences," p. 112; and "Lectures to Working Men," p. 155, par. 3.

‡‡ *Ibid.* p. 112. The text is not very clear, but we have endeavoured to extract the author's meaning. If we have not succeeded, the fault does not rest with us.

business to be astonished, but to deal calmly with them from a philosophical and not from a theological point of view; and this we shall endeavour to do as briefly as possible.

If we believed that the author meant by his broad declaration concerning "all the phenomena of the universe," that all material operations in nature are carried on through the instrumentality of secondary causes, we should (as would most of our readers) quite agree with him, and should experience some surprise that he considers it necessary to tell the world so; but from the mode in which he braces together "blind force" and "conscious intellect and will," which he regards as "co-ordinated terms in nature's great progression," we are not able to put this construction on his words.

Let us for an instant test the accuracy of this generalization, which we can do without departing from the field of scientific inquiry.

Heat, as we understand it, is a "mode of motion;" and when a moving material form comes to a standstill, or when it changes its nature, motion ceases, and becomes converted or transformed into heat, and *vice versâ*. In like manner, according to the author's general law, when an individual *brain* ceases to act as a brain, that particular mode of action, thought or intellect, *ceases to be;* and the matter having been converted into a plant, the action of thought becomes growth, and the brain no longer thinks, but—say, as a cabbage—grows.

If the author meets us by stating that he has not denied the independent existence of thought or intellect—that the *matter* of the brain only *grows*, just as it afterwards grows in the cabbage—then we must inquire what he means when he says elsewhere* that "all functions, intellectual, moral, and others, are the expression or the result in the long run of structures, and of the molecular forces which they exert."

We shall be glad to hear that he means something that we have been unable to discover; meanwhile we must take his meaning to be as above stated, and turning to his neosophy for "evidences" of the truth of this doctrine, we find—what?

First,—That man has a secular period in his existence.

Then is his spiritual existence that of a cabbage or cauliflower?

Secondly,—That he reflects occasional rays from the "source of truth," which rays have transfigured his nature.

Then what becomes of these rays, or of their *influence* on him, after his brain has ceased to reflect them? Do they also act in the *turnip or broccoli?*

And again, the new philosophy teaches that "the highest faculties of feeling and intellect begin to germinate in lower forms," and that there is "no mental distinction between man and the animals which immediately precede him in the scale (a generalization which the author is shrewd enough to perceive to be indispensable to the complete acceptance of his physical teachings).

But what evidence have we of the truth of these broad assertions? Is it to be found in the statement that "man is the only *consciously* intelligent denizen of the world?" or that he *alone* is capable of "reflecting rays

* Lectures, p. 154, par. 2.

from the source of truth?"—truths which have therefore no *existence* for the humbler creatures placed under his care and presented to him for his purposes.

If we were to treat our author's doctrines as he has treated the cautious teachings of Mr. Darwin, we should ask him why, in that admirable monograph which he published some years since in the *Microscopical Journal*, of an infusorial form, "Disteria," he said nothing of its loves or of its hates?—for the "germ" of love should exist even in its microscopical bosom!

In what "lower form" does that faculty germinate which enables man to comprehend and admire the harmony of the universe and the wisdom of its Maker?

But the author's distinctions and designations, when he travels out of his own sphere, are most mysterious, and often contradictory. Granted that man is the only animal possessing intelligible and rational speech (another very decided distinction between him and the lower animals), what are we to understand by "rational" speech? Suppose the speech of the parrot had been ever so perfect, or that the gorilla had been endowed with this attribute; would it have enabled *them* to accumulate experience? Or if, on the other hand, these animals had possessed such mental qualities as are now the heritage of man only, but no speech, would they not have risen in the scale of intelligence? May not, even now, a "dumb" animal, a cat or an elephant, be taught to perform rational acts, in consequence of its possessing certain lower psychical qualities in common with man? What has speech done to render man "consciously" intelligent? what *can* it have done? We would ask the author to say frankly, is it not *one* of the many media through which human reason and human will act; and according to every principle that he has enunciated, is not "rational speech" a misnomer?

Whichever way he turns he convicts himself of inaccurate reasoning. If man's "rational" speech be something distinct from the utterances of the lower animals, and is rendered so by the possession of *reason*, then there is a distinct line of demarcation between them, which cannot be bridged over by the discovery of the fossil bones of "an ape more anthropoid,"* or "of a man more pithecoid."† If, on the other hand, man owes his reason to his speech (as the author would have us infer), then whence have those animals derived their reasoning faculties, which possess no speech, and why are those having imperfect modes of utterance not more rational than those which have next to none? And again we ask, how can man through his speech have become "*consciously*" intelligent, whilst all his lower companions have remained unconscious of their intelligence?

But we will not pay our readers the sorry compliment to suppose that in studying this neosophy, they will not be capable at once of distinguishing between *facts* and well-grounded theories, and accommodating generalizations; and we must repeat, therefore, in somewhat different terms, called forth by the appearance of this second work of Professor Huxley's, our reason for thus analyzing his doctrines.

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* Man-like. † Ape-like.

They defeat what appears to us to be their author's most laudable object, namely, to secure to all men freedom of thought and expression on scientific matters; for in trespassing so rudely and inconsiderately beyond the limits of scientific inquiry, and indulging in wild speculations, he rather impedes than facilitates the progress of Truth.

Let us remind him, that if the organ of speech had been man's chief characteristic, he would *not* have been what he is. Guided by tradition alone, the multitude would have heard with satisfaction of an *auto-da-fé* in Jermyn Street, and no scientific inquirer would have been hereafter safe from martyrdom.

But are not such doctrines as we find in this work calculated to justify intolerance? Do they not give a colouring of justice to the anathemas which are, from time to time, launched against free scientific inquiry? We think they do, and our readers must decide for themselves.

If, then, it be the desire of the author and others (for he is not the only one to whom we could refer, who, under the guise of an iconoclast appears to throw doubt upon the evidences of design, and upon the all-pervading influence of a *First* Cause, in every natural phenomenon)—if, we say, it be the desire of the author, and others holding a high position in the scientific world, to see the veil of superstition withdrawn from human eyes, and the reign of reason ushered in, we recommend them to let the "scalpel" alone, and to allow the force of reason to burst the larval investiture of the age. *He* who teaches the insect to free itself from the pupa-case, will, *at the proper time*, aid mankind in its efforts in the same direction.

This operation the author can most effectively facilitate, by pushing on in his admirable and careful physical investigations, without importing into his works speculative theories and doctrines which have all the imperfections, without any of the moral excellences of those "superstitions" that they seek to supplant—dogmas which possess neither the recommendation of convincing the reason, nor of appealing to the heart.

Heat considered as a Mode of Motion. By Dr. J. Tyndall, F.R.S.

THE author of this excellent and interesting book states at the outset that he has in it "endeavoured to bring the rudiments of a new philosophy within the reach of a person of ordinary intelligence and culture." This statement is, we think, open to some explanation or correction with respect to the phrase "a new philosophy," especially as it is placed at the very outset of the work. The phrase manifestly refers to the view that heat is "a mode of motion."

To persons unacquainted with the present literature of the science of heat, or of the physical forces in general, such a view may perhaps be new; but to those who have perused the writings of Faraday, or particularly Grove, in his well-known work on "The Correlation of the Physical Forces," or of Helmholtz, Carpenter, and various other writers on the physical forces, heat, &c., such a view is not new, being abundantly and

prominently mentioned in those works; and it is less new to scientific men, all of whom have long been familiar with the idea of forces being "modes of motion." The phrase is not, however, repeated in other parts of the book. We consider that had the words, *the modern philosophy of heat*, or *the modern philosophy of force as applied to heat*, been substituted for the words "a new philosophy," the real facts of the case would have been more accurately described. The author has, however, in this excellent book, made this view of the nature of heat more popular and more demonstrable, by illustrating it with many beautiful experiments of his own and of other investigators, some of which are new ones.

At page 2, the author says, "For by mastering the laws and relations of heat, we make clear to our minds the interdependence of natural forces generally." This statement, though perfectly true, and applicable to the science of heat, is equally true and applicable with regard to each of the physical forces; and indeed it is correct of knowledge in general that a perfect acquaintance with any one branch discloses to us the interdependence of all branches of knowledge upon each other, and the general principles of that natural dependence and connection.

The experiments of boiling water by heat of friction (page 13); of igniting a mixture of air and bi-sulphide of carbon by suddenly condensing it in a glass syringe (page 29); of melting fusible alloy by rotating it rapidly between the poles of a powerful electro-magnet (page 37); of the contraction of india-rubber by heat (page 88); and the rotation of metallic balls by means of a voltaic current (page 104); some of which appear to be of the author's own devising, are carefully described and admirably illustrated.

We were sorry to see (pages 128 to 131), under the headings "General Laws of Professor Forbes," and "Laws tested experimentally," the comparison again brought forward of the author's more accurate conclusions with the less accurate ones of Professor Forbes respecting the vibrations produced by the contact of bodies of different temperatures; because having once shown ("Philosophical Transactions of the Royal Society," Part I., 1854) that the conclusions arrived at by Professor Forbes were incorrect, and having republished the paper in full in the "Philosophical Magazine," July, 1854, and again in the form of a lecture at the Royal Institution, Jan. 27, 1854, it appeared unnecessary to repeat the results in that form; the accurate conclusions might have been described, and the refutation of Professor Forbes omitted.

In Lecture VIII. (page 248) and its appendix (page 270), is a clear and full description of that most interesting experiment, the causing a flame of hydrogen burning in a glass tube to emit a musical sound, by pitching the voice to it at a distance in a proper note, and also causing that sound to cease by similar means.

In various parts of his book the author largely employs mental imagery for the purpose of illustrating his views. He speaks of the swinging of atoms (page 250); clashing of atoms (page 51); friction of atoms against pure space (page 33); the electric current knocking against the atoms, and imparting its motion to them (page 212); the passage of atoms from state of freedom to a state of bondage (page 153); the falling of atoms

down great precipices (pages 149, 150); &c., &c., as though he could actually see the atoms and distinctly follow their movements.

It is desirable, and even necessary, for the purposes of scientific investigation and discovery, to habituate the mind to a great variety of hypotheses, both abstract and otherwise, and to employ such images respecting the motions of atoms, &c. as *tools* in the daily work of scientific discovery; but we think such imagery, even though it be the most accordant with known facts, is not very suitable for conveying information, because of the great liability of unscientific persons to treat such conceptions as though they were real facts.

The book as a whole is beautifully written, and highly interesting on account of the number of good experiments contained in it. It is the most popular exposition of the dynamical theory of heat that has yet appeared. It contains the substance of the chief of the author's original investigations in the science of heat, particularly a valuable one on the action of gases upon radiant heat, which we have not space to criticise further than to observe that though not equal in degree of originality to the "Experimental Researches in Electricity" of his greatly talented predecessor, it represents a very large amount of labour, and manifests a high degree of accuracy in a very difficult subject.

Hints on the Formation of Local Museums. By the Treasurer of the Wimbledon Museum Committee. London: Hardwicke.

IT is every year becoming a question of greater importance how to find suitable employment for the increased intelligence of the working classes. Mr. Toynbee has solved the question in his own way: he says, the educated population of our parishes are surrounded by an inexhaustible profusion of objects adapted to improve and to gratify the understanding, and yet, for want of some plan of stimulating inquiry and observation, these treasures remain almost unknown. His little book, which is written in a thoroughly practical style, contains an account of a successful attempt to establish in Wimbledon a museum upon a plan which the author hopes may be found applicable to the formation of similar institutions throughout the country.

The feature which gives the present work an especial interest is its advocacy of purely local collections. On this point the author gives the views of Professor E. Forbes: "It is to the development of the provincial museums that I believe we must look in future for the extension of intellectual pursuits throughout the land." "When a naturalist goes from one country into another, his first inquiry is for local collections. He is anxious to see authentic and full cabinets of the productions of the regions he is visiting. He wishes, moreover, if possible, to study them apart, not mingled up with general or miscellaneous collections, but distinctly arranged with special reference to the region they illustrate. In almost every town of any size or consequence he finds a public museum; but how often does he find any part of that museum devoted to the illustration of the productions of the district? The very feature which, of all others,

would give interest and value to the collections, which would render it most useful for teaching purposes, has, in most instances, been omitted, or so treated as to be altogether useless."

The Wimbledon committee seem to have resolved that this charge should not apply to them: their museum is designated to "consist solely of such objects of interest characteristic of Wimbledon and its neighbourhood as may be found within a radius of five miles from the parish church;" and though the district is an ordinary one, the committee are encouraged by being reminded that "the end of a local museum is not the exhibition of rare and so-called curious objects; but to develope and foster in the minds of all classes of people an interest in the common objects of nature which surround them." On the willingness of the labouring classes to avail themselves of such opportunities as may be given them for the study of natural history, the present work contains some interesting and gratifying remarks. The author, "when busy among and intimate with many of the poor of London, distributed to several families small Wardian cases, and though of a very humble character doubtless to the benevolent mind of their inventor, not unacceptably still retaining his name. These Wardian cases consisted of an old soup-plate containing some mould, a few sprigs of lycopodium, or small ferns, and a bell-glass about six inches broad and eight high. In these glasses the poor were supplied with a constant view all the year round of the purest green leaves and the graceful forms of the slender stems bearing them. He (the author) will not soon forget the delight with which these presents were received, especially by the sick and bed-ridden, how affectionately they were watched, how they formed the subject of pleasant conversation time after time, and how some were to be seen carefully guarded after ten years' gratification had been derived from them. The price of these cases was about one shilling each."

Many suggestions are given to facilitate the establishment and arrangement of local museums. The author recommends, as a preliminary measure, the holding of a "chat-meeting," which he thus describes: "A chat-meeting is a simplification of a *soirée* or a *conversazione*. It originated in the idea that many parishioners having in their homes interesting objects, the examination of which would afford pleasure and instruction to their fellow-parishioners, would on certain occasions gladly take these objects to a room appointed for the purpose, and display and explain them. Suppose half a dozen parishioners to bring objects on a certain evening, each parishioner taking a table, and in a quiet chatty way showing and describing to his brother parishioners the objects; one exhibitor would not interfere with another, and several pleasant chats might go on at the same time at different tables: this constitutes a chat-meeting, and with ordinary care and scarcely any trouble, a chat-meeting may be made very agreeable, entertaining, and useful."

The work concludes with a description of the apparatus needed for the collection and examination of natural objects, and a classified list of the more useful and recent works on the animal, vegetable, and mineral kingdoms.

We have seldom read a book more exclusively directed to a single good purpose than the present. No display of learning is made, no favourite

theory is upheld; objections are answered and suggestions made, all in the simplest possible way; the author's name has to be incidentally made out by a reference to a list of the committee: not to gain applause, but to be useful, is evidently his aim, and we need hardly say that we heartily wish him success.

North Yorkshire; Studies of its Botany, Geology, Climate, and Physical Geography. By JOHN GILBERT BAKER. Longmans. 1863. 8vo., pp. 353.

THIS is the most philosophical attempt at a local flora which has yet been produced; a really noteworthy work, which, although treating largely of geology and kindred topics, must be regarded essentially as a botanical book. It is in nowise a popular treatise, nor is it abstruse, yet thoroughly scientific; the author being an original observer, who is content to write objectively, simply recording his facts in logical sequence, leaving the reader to make his own inferences. Hence the several sections are so far complete in themselves, that their consecutive dependance is by no means clear at a glance; the young geologist and botanist, the scientific tourist, local resident, and biological philosopher might each suppose the book made for his special use. Altogether it is well done.

The work is divided into three parts; in the first of which the geology, climate, and soils are treated with a view to their influence on the flora; in the second part are given the physical geography and topography, showing the localities and conditions under which the rarer plants occur; and, lastly, the botany, in which the flora is given in its relations to all these preceding circumstances.

As the studies on which it is founded have for the most part been made in the field, it is rather a book for out-door use and subsequent reference than one of those tourists' guides which beguile the hours of travel.

The chapter on geology is illustrated with a capital geological map, coloured to show all the important stratigraphical divisions. But the text confines itself to describing the physical features—subdivisions of strata, their thicknesses and trimmings out, appearance in the country, quarries and places where well seen—omitting all reference to the fossils and theoretical parts of the science.

The climatology also has a coloured map, showing the zones of altitude into which the Riding may be divided, which become the more interesting as corresponding for the most part with the limits of geological formations. The text gives abundant information on the zones, temperature, rainfall, winds, &c., with some account of the influences of these on cultivation and the indigenous flora.

The chapter on soils also has a coloured map, indicating the hardness and power of absorbing moisture of the different parts of the district, outlines which, as might be expected, correspond with those of geological deposits. These conditions necessarily affect climate and physical geography, and are indispensable to understanding the distribution of the flora.

The second part of the book is illustrated with a map coloured to show the districts drained by the several rivers. Here the author conducts the tourist about from dale to dale, pointing out the beauties of the scenery, its geological aspects, shows where rare plants may be gathered, and gives us their names; reminds us now and then of what has been sung by Wordsworth and Scott; and is altogether a pleasant and valuable companion.

The third part, on botany proper, is prefaced by a summary of conditions affecting a flora; and then follows a catalogue of the species. Here the author indicates in which of the drainage districts his plant is found, its range in height, the conditions under which it occurs, and the localities where it may be met with.

And, finally, there is an appendix giving an account of all the books, papers, and herbaria relating to the North Yorkshire flora, and an index of localities, and another of the genera of plants.

With all this material so systematically arranged, it is impossible not to regret that the author has not himself given some outline of those conclusions to which it cannot but have led. We would fain have learnt what variations the plant growing on the mountain-top presents when compared with the same species from the vale. We would gladly have been told whether the plant growing on clay was distinguishable from the same species inhabiting sandstone or limestone. We would have discovered what bearing all these external influencing conditions have on the flora, and what the significance of the limited range of a species may be. Perhaps Mr. Baker may yet be induced to give in some other form the results of his experience.

In conclusion, we can only urge all who go to North Yorkshire, and know the rudiments of botany or geology, to avail themselves thankfully of so luminous a guide as Mr. Baker.

MISCELLANEA.

SCIENCE ON THE CONTINENT.

Cultivation of Cotton in France.—The *Société d'Acclimatation* of Paris has for some time been engaged in encouraging the experiment of growing cotton in France, and the results now reported are certainly deserving of great attention. The Marquis de Tournes writes to the society that he is convinced that the cotton-plant may easily be acclimatized on the alluvial plains of Provence. "In spite of detestable weather," he says, "our crop surpasses that of last year; samples have been submitted to Messrs. Schlumberger, of Gnebwiller, who report that, allowance being made for ginning, our long staple cotton may be set down as worth ten francs per kilogramme [about 3s. 8d. per lb.], and our short staple at six francs and a half [2s. 4d. per lb.]!"

The *Séricicultare Practique*, published in the Vaucluse, says: "The 150 kilogrammes of seed received by the Society of Agriculture has not been sufficient to supply the demands of cultivators, and a further supply has been sent from Algeria, with valuable hints as to the modes of cultivation."

In the neighbourhood of Avignon the experiment is being carried out with energy by the Agricultural Society and many private individuals.

The results above given certainly surpass all expectation, and it will be an equally curious and important result if the difficulties in America should give rise to the practical cultivation of cotton in the south of France. There remains, however, the grand question of the cost of production; and it will be strange indeed should it turn out that France can compete successfully with India, Egypt, and her own settlements in Algeria.

It is well to mention, in connection with this subject, that M. Louis Reybaud, who was commissioned by the Academy of Moral and Political Science to report on the condition of the textile manufactures, arrives at the conclusion that it will not be safe to depend on cotton in future, and that the only safe course will be to use all possible efforts to replace it, to a large extent, by flax and wool!

The Manufacture of Steel.—M. Caron has communicated to the Academy of Sciences of Paris the result of a series of important experiments made with the view to ascertain the part actually played by manganese in the fabrication of steel, and the results are given in a few words:—First, that the phosphorus of the iron is not carried off by the manganese; second, that sulphur, even without refining, will disappear in presence of manganese; and, third, that silica is in a great part removed by the manganese. These

conclusions, says M. Caron, are confirmed by practice, for the minerals which yield the best steel frequently contain sulphur, but never phosphorus; and moreover it is remarkable that, although they contain coppery pyrites, the iron derived from them never contains sulphur. Manganese has, beyond question, the effect of rendering steel better and, above all, more durable; and this power is not difficult of explanation. When a sufficient quantity of manganese is added to grey cast-iron, of which the carbon is principally in a free condition, the result is white iron, in which the carbon is almost entirely in a state of combination. The effect is the same in the case of steel: a very small quantity of manganese is sufficient to retain the carbon in a state of combination, and to give to the metal those conditions which characterize steel of good quality. But the steel should never contain more than one two-hundredth part of its own weight of manganese, otherwise it becomes hard and brittle, the fracture assumes a crystalline appearance, and the metal loses a great part of its tenacity. Manganese has, moreover, the property of rendering steel capable of being welded, which is not so without its aid. It is not uncommon, in order to improve the quality of iron, to mix ordinary and manganesian iron together, and then to refine the mixture; and M. Caron says that he has learnt by experience that the purifying power of the manganesian iron is in direct proportion to the amount of the manganese present. It is therefore most important, he adds, to reduce the manganesian ores in such a manner as to retain the largest possible quantity of manganese in the iron. The spathic iron ore of Siegen contains 15 to 20 parts of manganese to 100 of iron, and yet the cast-iron derived from this mineral only contains from 6 to 7 per cent. of manganese; but if, by a modification of the furnaces, or a change in the nature or proportions of the fluxes, the amount of the manganese in the iron could be raised to 10 per cent., it is certain that cast-iron of very great commercial value would be the result.*

M. Caron promises further communications on this very important subject in a short time.

Preservation of Wood.—Considerable attention has been given of late to this important subject in France and Belgium, and M. Pottier, of the University of Ghent, has recently presented a memoir on the effect of the creosote process to the Royal Academy of Belgium. He therein details his experiments with the heavy oil of gas-tar, and arrives at the conclusion that of the various ingredients which enter into its composition, the volatile hydrocarbons, aniline, phenic acid, and napthaline possess no preservative qualities whatever; and that the green oil which is produced by the distillation of gas-tar at a temperature of about 570° is that which is most effective in preventing the destruction of wood.

M. Lapparent, Director of Naval Construction in France, has been engaged in investigating the subject from another point of view. Having been impressed with the effect of the old method of charring posts and other timber to be fixed in the ground, he made a series of experiments on the causes of the destruction of timber and the action of carbonization as

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* See also Summary of Metallurgy.

a preventive; and arrived at the conclusion that the practice alluded to contained the elements of a very valuable means of preservation. M. Lapparent believes that the effect may be produced without any material destruction of the wood, and that all that is required is a very thin coating or deposit of empyreumatic products, or, in other words, that the necessary carbonization may be obtained without any alteration of the surface of the wood, or any diminution of the sharpness of the angles. He makes use of a jet of gas, mingled with a current of compressed air, in order at once to produce a more active combustion, and to give a more decided direction to the flame. It matters not what gas is used so that it give a great heat in burning. When the pieces of wood to be carbonized are small or light, they are passed over the flame of gas by hand, but in dealing with heavy timber, or with pieces fixed in position—such, for instance, as those of a ship upon the stocks—the heat is applied by means of a nozzle in connection with two elastic tubes, one supplying gas and the other atmospheric air under pressure. M. Lapparent says that specimens of wood of various kinds thus prepared have been placed in a dunghill side by side with unprepared pieces of the same timber, and that at the end of six months decay had attacked the latter in a decided manner, while the former remained perfectly untouched.

This process is particularly recommended in the case of hard woods, which can with difficulty be impregnated with those antiseptic substances which are so effective with timber of the softer kinds. Wood prepared by M. Lapparent's process is being submitted to trial in the Imperial dockyards of France, and also by the railway companies; and it is contemplated to apply it also to carpentry and cabinet-making. We are also informed that similar trials are being made in the English dockyards.

Imperfection of Lightning Conductors.—The attention of the French Academy of Sciences has been drawn by M. Perrot to the important question of the inefficiency of the conductors in general use. Three propositions, derived from a number of experiments, are laid down by M. Perrot:—1st, that the surface of the conductor in contact with the water of the soil is generally so insufficient for the rapid dissemination of the electric current, that the conductor cannot be struck with lightning without becoming itself dangerous to the objects in communication with it; 2ndly, that the ordinary conductor is, however, sufficient to give passage to a constant current of electricity sufficient to neutralize that of an approaching storm; and, 3rdly, that in order to arm the common conductor against danger from thunderstorms, the rods should be furnished with a number of long, thin, divergent points of a high-conducting material. The experiments of MM. Pouillet and E. Becquerel have shown that pure water conducts electricity 6,754 millions of times less than copper, and M. Perrot therefore concludes that the surface of water in contact with the conductor should be that number of times at least more extensive than that of the copper. If, therefore, he says, the section of the conductor be equal to one square centimètre, the surface in contact with the water should be equal to 675,400 square mètres, whereas it rarely amounts to more than the tenth of a square mètre. The submerged surface of the conductor is therefore generally about ten thousand times less than it should be, and presents

ten thousand times more resistance to the electric fluid than the other portions of the rod itself, so that when such a conductor is struck it presents a resistance in proportion, and becomes dangerous to surrounding bodies.

The following instructive experiments have been made in support of these deductions:—One end of a rod, representing a lightning-conductor, having been placed at explosive distance from the conductor of an electric machine in communication with a Leyden jar, the other end was plunged into water contained in a metallic vessel in communication with the exterior of the jar and with the earth, the rod itself being isolated in order that one electric current should not neutralize the other without passing through the water. The machine having been set in action, the electricity, instead of traversing the water without flash or noise, presented itself on the surface in the form of a brilliant star, the rays of which stood out from the submerged conductor often to three times the length of the spark of the machine. "In order," says M. Perrot, "to test the electric tension at various parts of the conducting-wire, and consequently the danger to surrounding objects from an ordinary lightning-conductor, I applied a metallic sphere, and found that it was struck at distances varying from a fourth to a third of the length of the spark from the machine."

It is impossible to overlook the practical importance of these experiments and deductions, which demand careful examination by electricians.

THE SARBONNE.—Some few weeks since the learned world was considerably interested, and some of its members rather scandalized, by the fact of a young lady being admitted to academical honours. The other day another curious incident occurred within those ancient walls, where the Admirable Crichton carried off so many laurels in competition with the most brilliant scholars of his day. A young man born deaf and dumb having been received as a bachelor in the literary section, the examination was conducted in writing, the proficiency of the candidate being thoroughly established. This gentleman is the second son of the Comtesse de Chastellux, daughter of the Duchess de Rantzan, and one of four brothers, three of whom are deaf and dumb.

THE ACADEMY OF SCIENCES has elected Admiral Fitzroy a corresponding member in the section of geography and navigation, in the place of the late Admiral Sir James Clark Ross.

ENGLISH STEAM-ENGINES FOR THE FRENCH NAVY.—A considerable number of eminent engineers and other scientific men, French and English in Paris, were invited a week or two since to see a beautiful working model of a pair of screw engines now being manufactured for the French man-of-war *Vienne*, building at Toulon. These engines were ordered by the Emperor of Messrs. Jack & Co., of Liverpool, and of the same pattern as those supplied by that firm to many mercantile steamers, but not yet, as we believe, introduced into the British Navy. The two great objects in view in Messrs. Jack's arrangement are direct action upon the screw shaft and economy of fuel. The cylinders are on the Woolf principle of high pressure and expansion combined. The chief peculiarity, however, is the arrangement of the condensers, which are on the principle known as

surface condensation,—that is, the steam to be condensed passes through a long and tortuous series of tubes, which are refrigerated by a constant flow of cold sea-water made to circulate by pumps worked by the engine; the great object of surface condensation being to leave the condensed steam free of any intermixture with the salt-water. The mechanical arrangement adopted by Messrs. Jack & Co. is curious. The framing of the engines is entirely tubular, and the condensers occupy the spaces between the plates that form the walls of the frames; this affords space within the latter for an immense extension of condensing tubes, and also for the use of a proportionately large quantity of sea-water as a refrigerant. Another feature is the "feed-water heater," by means of which the exhaust steam is made to part with its heat to the condensed steam which feeds the boiler, entering the latter at a high temperature. We need not inform our practical readers that the great problem of the day in marine engineering is the economy of fuel, and the consequent increase of the distance that a steam-vessel can run without coaling, and Messrs. Jack & Co. seem to have achieved an important step in that direction. The working of the model was admirably explained by a gentleman connected with Messrs. Jack & Co.'s establishment, and seemed to give great satisfaction. Some surprise was expressed that the Imperial Government should have preceded the English Admiralty in putting to a practical test the asserted advantages of this form of engines for screw men-of-war; but British inventors and manufacturers know too well that private firms are held in little honour in their own country, or at any rate by their own Government. Y.

PARIS, *June*, 1868.

FALSE MOONS, OR PARASELENÆ.

As the occurrence of paraselenæ, or false moons, is rare in these latitudes, I send a short account of the appearances which presented themselves to the inhabitants of this small town and its neighbourhood on the night of May 29th, 1863. I find no mention of the phenomenon in the local papers of this day (June 6th), or in the London papers of the week past, and imagine therefore that it was seen by comparatively few. The day had been hot, with a W.N.W. wind bearing dark, heavy masses of cumulus. In the evening the moon was bright, but slightly veiled by a thin layer of misty cloud. At about 9.40 p.m. two false moons of great brilliancy appeared east and west of the true moon; they showed prismatic colours, and each was adorned with a comet-like tail stretching outwards. They were united by a circular halo of about 40° diameter, the upper arc of which was very distinct and beautiful. At about eleven o'clock a smaller halo very finely coloured encircled the moon; it had a diameter about three times that of the moon itself. These interesting phenomena continued visible with varying brilliancy until midnight.

I send a diagram of these appearances to help out my faulty description.

THOMAS EDWD. AMYOT.

DISS, NORFOLK, *June 6th*, 1863.

PROVINCIAL INSTITUTIONS AND SOCIETIES.

MIDLAND SCIENTIFIC ASSOCIATION.

THE report of the proceedings of this society has reached us too late to admit of a lengthy notice. On the 8th April a meeting was held at Bank House, Burton-on-Trent, when the following papers were read by members :—

"On the Benefits and Injuries to Agriculture by Small Birds," by Mr. Edwin Brown. The author advocated the exterminating work of sparrow clubs; these birds being, according to his views, very prejudicial to agriculture. Great difference of opinion prevailed on the subject amongst the members, some of whom supported whilst others opposed the views of Mr. Brown.

The Secretary then read a paper contributed by the Rev. W. Coleman, "On the Indications of Combustion prior to the Glacial Epoch, in a Bed of Coal near to its Outcrop," and afterwards exhibited a specimen of coal containing ramifying veins of galena, or lead ore, found in a disused colliery in Leicestershire.

Mr. Knobel next read a paper "On the Occurrence of Native Metals."

Then followed an address by Mr. Edwin Brown, "On the Possible Effects on Vital Phenomena of Tea when used as a National Beverage." The author believes that the use of tea is calculated to lower the vital energy of the consumer, and that possibly in the course of time a large use of tea may reduce us "to the physical stamina of the Chinese."

After one or two remarks from medical men,

Sir Christopher R. Lighton jocularly expressed the hope that Mr. Brown had not been bribed by the brewers of Burton to bring on the subject.

"The general opinion of the meeting appeared to be that tea enables the mental worker to perform his task with greater ease, but that used as the sole beverage it has a lowering effect ultimately upon the human frame."

Thus ends the report. Did the discussion take place before or after a repast? And to what beverage were the members obliged to resort in consequence of Mr. Brown's paper?

THE WARRINGTON FIELD NATURALISTS' CLUB.

This society, which was inaugurated in the spring of 1862, under the presidency of T. Glazebrook Rylands, Esq., F.L.S., held its first anniversary meeting on the 8th of April. The proceedings were rendered exceedingly interesting by the exhibition of geological, botanical, and other specimens, including some of great rarity and interest. The geological department was under the care of Mr. Paterson, manager of the gas works, who kindly lent a series of valuable fossils, chiefly from the Carboniferous formation of the North of England. Tables were also set apart for plants, both native

and exotic; and several microscopes, belonging to members and others interested in the society, revealed some of the beauties of the infusorial world.

The president delivered a very interesting address, in the course of which he set forth the advantages—especially to working men—of cultivating a taste for the study of nature, and gave instances of men who, after beginning life in a very humble way, had attained considerable eminence in the scientific world.

Mr. Peers, the secretary of the society, read the report for the past year, from which it appeared that forty-four ordinary meetings had been held. There were twenty-eight members on the books,—twenty-five ordinary and three honorary. The herbarium of the society contained about three hundred and sixty species of British plants, the greatest portion of them gathered in the neighbourhood by members during the past year. The thanks of the society were accorded to the Rev. R. Rolleston for gifts of specimens of plants, both fresh and dried; to Robert Davies, Esq., and Alexander Irvine, Esq. (editor of the *Phytologist*), for specimens of dried plants; to William Wilson, Esq., for several specimens, amongst which were *Potamogeton lanceolatus* and *Carex divisa*, which, coming from that source, must be considered authentic; and to the Mechanics' Institution for the use of a room for meetings. The expenses of the Society had been trifling, and the terms of membership were fixed at the lowest possible figure.

The report having been adopted, Mr. Peers read a paper on the botany of the district, illustrating it by means of dried and fresh specimens, especially pointing out the most important natural orders represented in the neighbourhood.

Mr. Cash (treasurer to the society) read a paper on "Microscopic Life in the Neighbourhood of Warrington," in the course of which he referred to examples of the more important Rotifera, Protozoa, and Protophyta, which had come under his observation. He exhibited living specimens of the rare and beautiful *Stephanoceros Eichhornii*, and several other interesting creatures; and mentioned, as common in the district, *Melicerta ringens Floscularia ornata*, and several others.

Mr. Green read an interesting paper, the object of which was to show the pleasure to be derived from a study of the works of nature. After which, Mr. Paterson, at the request of the president, made some remarks explanatory of the fossils which he had been kind enough to bring.

Mr. Cooper (curator of the Warrington Museum) afterwards read a paper on the subject of Entomology, the claims of which he warmly advocated.

At the conclusion, a cordial vote of thanks was passed to Mr. Rylands for presiding, on the motion of the Mayor of Warrington (James Shepherd, Esq.)

ROTHERHAM LITERARY AND SCIENTIFIC SOCIETY.

The town of Rotherham and the adjoining parish of Masbro' have been, until recently, deprived of the benefits of a literary and scientific society;

but the enterprise of a few intelligent men has filled up the void, and on Monday, the 12th January last, the Rotherham Literary and Scientific Society was inaugurated in the Lecture Room of the Mechanics' Institute, with an able address from the Rev. H. Master White, one of the Vice-Presidents of the new society.

This gentleman, along with Mr. Percy Smith, Mr. Beale, Mr. Haywood, the "Greave of the Feoffees" (the leading functionary in Rotherham), and a few others, had been at work some time previously, as a provisional committee for drawing up rules and obtaining subscribers; and they had succeeded in enlisting the support of most of the friends of literature and science in Rotherham and its vicinity.

The opening address was upon "Literary and Scientific Societies," in the course of which the lecturer ably reviewed the history of these societies from the earliest ages. In Ancient Greece, he said, there were, strictly speaking, no literary societies; the followers of the various philosophers met rather as pupils than as equal members of a society. The Roman law was jealous of all voluntary associations. After touching upon the monastic institutions, and expatiating upon their value in the preservation of learning through the dark ages, the lecturer stated that the first "Literary Society," in our sense of the term, was founded about the year 1572, by Archbishop Parker; that it flourished during the reign of Queen Elizabeth, but was suppressed by James I. About the year 1718, however, its meetings were resumed at a tavern in London; but in 1750 it obtained a Royal Charter, and was placed on a firm footing.

After giving a sketch of the origin and growth of the Royal Society, and illustrating from its earlier papers the ignorance which generally prevailed in the 17th century, Mr. White said that two principles had led to the formation of most "Scientific Societies." One was that, as the field of knowledge had been enlarged, it had been found impossible for single individuals to explore more than a small part of it thoroughly. Societies were therefore required, composed of the workers in special subjects. Such societies were the Botanical, Zoological, &c. The other was that the connection of the various parts of the natural world became more striking as the more abstruse laws of each were discovered. Societies were, therefore, wanted to bring together the students of different branches. Such a society was the "British Association for the Advancement of Science." But while he had been speaking of "Literary Societies" and "Scientific Societies," he said nothing of those which, like their own, professed to be both literary and scientific. He trusted, however, that he had said enough to show the boundless field before them, and the way in which even humble contributions may be serviceable to the general store.

Having concluded his review of kindred societies, the lecturer referred to the social and moral benefits to be expected from the one they were met to inaugurate; and at the conclusion of his address, one of the Secretaries. Mr. Percy Smith, announced the mode in which the proceedings of the Society are to be conducted. There will be monthly Lectures, to be delivered by private individuals residing in the town, which will be followed by discussions; and occasional paid lecturers will be engaged to deliver courses of lectures on literary and scientific subjects. The Secretary

encouraged the members of the Society to throw off that reserve which usually stands in the way of free discussion, and not to dread the results of what he humorously characterized as pugilistic sparring with their master, in the Science. He then called upon Mr. James Samuelson, of Liverpool, (who was present by invitation), to take part in the proceedings.

Mr. Samuelson, after expressing his wishes for the success of the Institution, drew the attention of its members to the movement which is now taking place for the popularization of Science in Great Britain, as exemplified in the Naturalists' Field Clubs and Science Classes daily springing into existence, and warmly recommended the founding of these in connection with the new Society. Having referred to their success in other towns, he said that he felt sure they would be attended with great benefit in the heart of so large a manufacturing district as that in which they were assembled.

An animated discussion followed.

Mr. George Haywood (Greave of the Feoffees) gave some account of the progress of the Rotherham Mechanics' Institute, and said that their great difficulty lay, not in obtaining pupils, but teachers. He thought this difficulty would be removed by the remuneration given by Government to teachers of the "Science Classes" mentioned by Mr. Samuelson.

Mr. Beale, the second Honorary Secretary, stated that the "Penny Lectures," at the Midland Institute, in Birmingham, to which reference had been made, owed their success to the practical nature of the subjects on which Lectures were delivered; and he recommended that the same course should be adopted at Rotherham.

Several other members followed: and the first Lecture and subsequent discussion certainly gave great promise of an energetic movement in the right direction, inaugurated by the Rotherham Literary and Scientific Institute.

THE WEST KENT NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

This society reckons amongst its members some of the leading men of science in England. Its president is Frederick Currey, Esq., F.R.S. (one of the editors of the *Natural History Review*), and in the list of its committee and members we find the names of Mr. Glaisher, F.R.S., Professor Bell, Professor Morris, Rev. J. G. Wood, and others of known repute. The Report of the past year is highly satisfactory: the funds of the society are flourishing, the members (113) on the increase, and the meetings interesting and diversified. The excursions are not frequent, there having been only one during the whole of last summer. The *soirées* are well attended, and rendered interesting by the exhibition of microscopes, of which more than fifty were contributed on one occasion. The most interesting feature in the last year's proceedings of the society was a paper read in October by James Glaisher, Esq., one of the vice-presidents, on which occasion a very crowded meeting, at which many ladies were present, listened to him with much pleasure as he detailed the particulars of his late balloon ascents, made at the suggestion of the British Association, and conveyed to his hearers, in a pleasing and popular form, and by the aid of excellent diagrams, the scientific results obtained by his aërial

voyages. In addition to its gatherings, the society is employed in the collection of microscopical specimens, for which a cabinet has been purchased; and we would direct the attention of dwellers in seaports to the fact that this society is collecting, and solicits contributions of deep-sea soundings, especially of such as contain Foraminifera.

We are a little puzzled to discover where are the head-quarters of this society. We presume in Greenwich, where the Report is printed; but as the President lives in Blackheath Park, and the Secretaries at Lewisham, it would be well if some hint were given to intending subscribers concerning its *locus in quo*. West Kent is a large place!

MANCHESTER FIELD NATURALISTS' SOCIETY.

The report of this society for 1863 shows that it is daily extending its sphere of usefulness. Its excursions and soirées have been fruitful in results; and the most interesting feature in its transactions appears to be Mr. Holland's address on poisonous plants.

The specimens collected to illustrate the lecture comprised the following (with others of less importance), and those from which any danger was apprehended to the audience were enclosed in glass cases:—

Living Plants.—*Helleborus fœtidus, Aconitum Napellus, Daphne Mezereum, Digitalis purpurea, Cicuta virosa, Mercurialis perennis, Buxus sempervirens, Colchicum autumnale, Arum maculatum*, &c.

Dried Plants.—*Chelidonium majus, Hyoscyamus niger, Atropa Belladonna, Œnanthe crocata, Conium maculatum, Veratrum album*, &c.

Products and Preparations.—Opium, morphia, bitter-almonds hydrocyanic acid, nux vomica seeds, strychnine, and various other seeds and poisonous alkaloids.

Mr. Grindon, the secretary, also delivered a very able lecture on the "Prefigurations of Nature," in which he showed that external nature everywhere abounds in objects which prefigure other higher ones; and he selected his illustrations from the inorganic as well as the organic world. His lecture did not deal with the theory of development; but tended to show that all nature is founded upon one great plan, and that *man* is the "summary and synthesis of all other natural objects."

We are glad to observe that prizes are now granted by this club to the ladies who make the best collections of plants of various kinds at each excursion.

DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY AND FIELD CLUB.

This flourishing society was established last year, on the foundation of a former geological society which once existed in that neighbourhood, but which, under a somewhat too rigid mode of management, had not in it very much vitality. The new society seeks to combine the main features of a field club, archæological association, practical miners' society, and general scientific body, and has hitherto met with an amount of support and success that augurs well for its future prosperity. It has now nearly 400

members on its lists, it is affiliated with all the leading scientific societies in the midland counties, some of the most eminent names in geological science are among its corresponding members, and many of the papers which have been read at its meetings are remarkable for their practical utility. No less than eight field meetings have been held, for the purpose of examining the interesting geological and scientific features of the district; and several evening meetings have also been held, when fossils and scientific apparatus have been exhibited, and papers have been read and discussed. The annual meeting was held on the Wednesday and Thursday in Witsun week, and was most numerously attended, not only by scientific men from the surrounding district, but also by many well-known gentlemen from London and other places. The proceedings included excursions through the limestone workings at the Wren's Nest Hill, and through the famous Silurian caverns of the Castle Hill, which were brilliantly illuminated for the occasion by the Earl of Dudley. Some idea of the extent of these excavations may be formed from the fact that upwards of 3,000 candles, exclusive of lamps and coloured fires, were used in the illumination. Mr. J. W. Salter delivered an address in the largest cavern, and at an earlier part of the day Mr. S. H. Blackwell read the annual address (which was an elaborate *résumé* of the progress of geological science for the last twenty years), and Professor Tennant gave a lecture on "The Connection between Mineralogy and Geology." In the evening Mr. Blackwell showed some splendid experiments on the combustion of iron on a large scale. The following day the party went to inspect one of the Earl of Dudley's coal-pits near Dudley; and here again the Earl, with his accustomed liberality, caused the whole of the workings to be illuminated. Several hours were spent in examining the peculiarities discovered in the mining operations, especially with reference to the intrusive basalt and greenstone in one part of the pit. The whole of the two days' varied proceedings were extremely successful. We notice that field days are arranged for Malvern, South-Western Shropshire, Wenlock, and Matlock, and arrangements are in progress by which more practical importance may be given to the society's operations. We shall be glad to record the progress of the society, and to witness its development.

SOCIETY OF AMATEUR BOTANISTS.

METROPOLITAN CLUB (LIBRARY), 239, EUSTON ROAD.

This "Field Naturalists' Club," recently established in London, is one of a high order, and deserves the encouragement, not only of those who desire directly to participate in its advantages, but of all who are interested in the advancement of Science.

It is one of those Institutions the establishment of which, in some new locality, we have to record in each succeeding Number. An Excursion Club; an Association for the interchange of specimens; reading of Botanical papers; and for the establishment of a local Museum, Library, and Herbarium.

The subscription fee is 2s. 6d. per annum. The indoor meetings will be held fortnightly, in addition to the outdoor excursions. The system of granting prizes to successful collectors will be adopted by this Society; and the first prize, offered for competition by the President, Mr. M. C. Cooke, is "Berkeley's British Mosses."

We hope that those amongst our metropolitan readers who are anxious to promote the spread of botanical knowledge will give their support to this Society, which is established for the special study of this branch of science.

FRENCH WORKMEN ON THE LONDON EXHIBITION AND ENGLISH MANUFACTURES AND WORKMEN.

BY G. W. YAPP (PARIS).

THE commission of French ouvriers appointed to examine and report on the products of various countries to be seen at the International Exhibition, and to inquire into the manufactures pursued in our own country, has just commenced the publication of its reports. They are short, pithy documents, the longest of them only occupying thirty odd pages of small size.

It is not at all surprising that the tone of these reports is very different from that of many which have appeared on the late and other Great Exhibitions: the French workmen had a deep interest in their labour; they set about it in a plain, straightforward, and practical spirit—very different from that dainty *dilettante* manner which unfortunately characterizes many documents on such subjects, and which makes them unacceptable to practical men. The delegated workmen knew well the weak points in their own case, and of course measured English products and English workmen by their own standard and by the light of their own grievances.

The series of reports which will record the impressions made on the minds of men, selected by their fellow workmen in each class of industry at home, not only by the products seen in the Exhibition at South Kensington, but by an examination of factories and workshops of London, and by visits to the homes of our own industrious producers, cannot fail to be deeply interesting to all classes of enlightened and practical Englishmen; nor will the effect produced in the minds of the reporters by their reception here, be without interest for all who desire to see the prejudices swept away and the grand industrial contest pursued boldly but generously between us and our rivals.

1. *Report of the Tanners, Curriers, and Morocco Leather Workers.*—This and other reports are preceded by a short historical notice, after which the ouvriers give the general result of their observations in a few paragraphs. They say they are convinced that, on the whole, France excels her rivals in the preparation of leather and skins, and that although England, Germany, and Switzerland are superior on certain points, the French manufacturers have nothing to fear, and that the materials and processes employed in England are inferior to those of France. At the same time

they warn their countrymen that they must not sleep, for that they may then be overtaken, or even surpassed by the English, who are ever on the search after improvement, and who act with intrepidity and disregard of expense in order to dispute with their rivals the first position in foreign markets. The reporters then remark in detail, but briefly, on the whole of the productions in their class shown at the Exhibition. We cannot follow them through these special notes; suffice it to say that our Moroccos are well spoken of, that English calf leather is generally condemned as wanting in suppleness, that our sole-leather is accused of sponginess, that our dressed pig-skins for saddles and other purposes are declared to be perfection in their way, and that some of our bookbinder's calf is highly lauded.

Finally, the reporters give an account of what they saw of the London factories, and of the impression made in their minds by a comparison of their own condition with that of English workmen in their own class; and we are sorry to find from the report that the delegates were so ill-satisfied with the reception afforded them by the master tanners and leather-dressers, that they express a hope that any future commission may have better opportunities. The reporters are of opinion that France excels in the fundamental part of the leather-dressing, namely, tanning—both as regards material and manipulation; and they express an opinion that the universal tendency of the English to substitute machinery for hand labour may contribute to their inferiority in this respect. It is admitted, however, that some firms in London approach nearer than those of any other country to the French standard, and that in the preparation of pig-skins we stand unrivalled—a superiority which is curiously attributed "solely to the care which our neighbours exhibit towards the porcine race," as if poor piggy's education involved the first principles of tanning his hide.

But the remarkable portion of these reports is the positive evidence of the superior position of the English as compared with the French workman. "Certainly," say the reporters, "we could not expect that in this comparison France would take the first place." On the contrary, the report declares that, "during the last forty years, the causes of complaint have grown like the snowball," and that "no one can expect French workmen to glorify their present position." Again—"France no longer ranks in the first class of nations in the eyes of those who see the miserable pay she gives her children, her workmen of all classes, whether industrial or agricultural."

The French workmen naturally regard with great interest the freedom of combination and discussion enjoyed by Englishmen, and declare that employers in France act, in the matter of wages, in a narrow and arbitrary spirit. As regards the comparative rates of payment in the two countries, the following passage is too striking to be omitted:—

"The wages paid in England since 1812 are, on an average, 30 per cent. higher than those received by French workmen, and in the case of waxed calf the English workman makes twice as much as his brother in France!"

This enormity, says the report, is in no way counterbalanced by the expense of living; for the delegates declare that they lived with English

workmen for some time, that they had the best of opportunities of judging, and that they are convinced that the necessities of life are quite as cheap in London as in Paris.

2. *Report of Lithographers.*—The delegates in this trade complain that many of the works in the Exhibition were hung so high that it was quite impossible for any one to judge accurately of their execution. Some reproductions of works of art, in colours, from Munich, are spoken of in laudatory terms, as regards workmanship and cheapness, although the artistic ability is considered to be mediocre. As to the English lithographic copies of water-colour drawings, the report says :—"They exhibit a truthfulness and richness of execution of which we had no conception," and that "the great success they have achieved with the public is perfectly intelligible." The delegates were, however, astonished at the great number of stones used in the production of some of the more elaborate works, and declare that in France the co-operation of the artist and the ability of the printer would enable the French lithographers to dispense, in many cases, with one-third of the number. The English mode of drawing on the stone is described as peculiar, and as leaving nothing to be desired on the score of fineness and solidity. Another grand point of superiority in England is declared to be the paper, in which respect the French lithographers are said to be worse off than those of any other country in the world.

The English paper, says the report, is as supple and as well adapted to take up the colours, without injury to the stone, as ours is hard and unfitted for its work. In another place the paper in use in France is declared to possess no one good quality whatever but its whiteness.

In lithographs executed with crayons and tints on three or four stones, the French workmen claim superiority over both the English and Germans; and, as regards works in black and white, the reporters say that England has not yet, apparently, found lithographic artists of sufficient talent to stand against copper-plate engraving, which she holds in such high estimation; while the writing of English lithographers is spoken of with the highest admiration, the reporters declaring that the beauty of some of the specimens which they saw almost surpassed belief.

Like the tanners, the lithographers visited some of the London establishments, but, unlike the former, they speak in the highest terms of the courtesy with which they were received, and of the openness with which all the modes of operation were exhibited to them. "On the part of the workmen," says the report, "there was none of that obsequious curiosity which assails visitors in our ateliers; the well-behaved apprentices had none of the bantering effrontery of our own, but everywhere we were received with a gravity as cordial as temperament and the difference of language admitted."

The systems pursued by the publishers of England and France are contrasted entirely in favour of the former, that of the latter being denounced as narrow and parsimonious in the extreme, and as tending only to the production of cheap and bad work.

As to the condition of the working lithographer, the report says :—

"We found, as we indeed already knew, that for piece-work the English

received *more than double* the sums paid in France; while for day-work the advantage is greatly in favour of the former. In France, the payment remains the same, insufficient, while the cost of living and food increases every day."

The liberty which the English workman enjoys, and which, says the report, he knows so well how to use for his own interest and improvement, naturally calls forth the admiration of the delegates, who say that none but the masters are allowed to combine in France, and that the consequence is the reduction of wages, the deterioration of the product, and the ruin of the trade. The French visitors found the English lithographers better lodged and better fed than those of France. Lastly, say the reporters:—

"The English are stronger than we are; they do not kill themselves at their work."

AUSTRALIAN EXPLORATION.

THE extension of our geographical knowledge forms one of the most interesting features of the present day, and the adventurous spirit for which the Anglo-Saxon race are so famous finds constant food in the fields of discovery which yet lie unexplored in distant and difficult regions of the globe, but which are by degrees being opened up by the indomitable perseverance and unflinching energy of brave and daring men. The discoveries of Livingstone, of Speke and Grant, and Petherick, are results of successful exploration by men who have been so fortunate as to achieve the end they contemplated, though they carried their lives in their hands in order to attain it; but the mind recurs with gloom to the sad fate of others not so fortunate, who, like the ill-fated Burke and Wills, overcome by the inhospitality of the regions they traversed, succumbed in the wilderness, and left their bones bleaching in the far interior of Australia. All honour to such men, to whom the sweet reward of a safe return to the abodes of civilized life, and the acclamations of their appreciating fellow-men have been denied—who have thus offered themselves as sacrifices to scientific investigation and a thirst for knowledge of the unknown.

From such a sad picture it is a relief to turn to the success which has lately crowned another attempt to cross the vast continent of Australia, and the return of Mr. Stuart's party to Adelaide. This explorer, it will be remembered, left Adelaide in the beginning of the year 1862 to complete the exploration which he commenced in 1859, and which for the second time he was unable to finish in 1860. On the first occasion he was turned back by hostile natives, and on the second occasion by a dense scrub which separated him from the Victoria River, after he had reached as near to the coast as latitude 17° and longitude 133°. In this third expedition, however, Mr. Stuart has been completely successful. After crossing to latitude 17°, upon his old route, he found in the course of a lengthened examination of the country, that the belt of scrub, which

had seemed to hem him in hopelessly from the coast before, was penetrable in a northerly direction; and instead, therefore, of further seeking to reach the Victoria River, he pressed forward through Arnheim's Land, and came out upon the coast near Point Hotham, opposite Melville's Island. Thus there is now a direct route from Adelaide to Port Essington, and more than three parts of the country through which it runs has been traversed by Stuart and his party *six times*, this being the third consecutive year that his expeditions have crossed and recrossed this continent. From these facts it will be seen that the exploration is one of vast importance to all the Australian colonies. The journeys of previous explorers who have crossed the continent have terminated at the Gulf of Carpentaria, where the country is low and swampy, and where ships trading with India and China would meet with difficulties in navigation. But a route is now opened from South Australia to a point on the coast six degrees beyond the head of the Gulf, which was the place reached by Burke, and afterwards by McKinlay; and this route is found traversable during the driest of seasons.

The peculiar features of travel in the interior of Australia are well illustrated by a reference to Mr. Stuart's diary, which chronicles the movements of the party from day to day, the appearance of the country, and the natural productions met with, though these last are not described with any scientific accuracy. As far as Newcastle Water, in latitude 17° the route had been several times traversed, but from that point Mr. Stuart's journey was through a new country. Here he was in the middle of April, 1862, the weather very hot, strong winds often blowing during the day, and the falling of the wind at night being the signal for troops of mosquitoes and flies to appear, much to the annoyance of the travellers. With such hot weather he dared not attempt to make the Victoria River, for the horses would not stand a 140 miles' journey without water, the discovery of which was always precarious. Indeed it may be said that a journey of exploration across the continent of Australia resolves itself into a constant search after this indispensable necessary. Water-holes were occasionally met with, sometimes, however, dry, and sometimes merely the deeper parts of the beds of dried-up creeks, and rivers through which water flows during the rainy season. The appearance of a few birds from time to time, such as slate-coloured cockatoos, pigeons, &c., announced the proximity of water, and was therefore always a welcome omen. To add to the difficulty, it was soon discovered that their water-bags, on which their progress, and indeed their very lives, depended, were not by any means satisfactory. On the 8th of May it appeared that the water-bags in a journey of 21 miles had leaked out one half of their contents, and the same circumstance was a frequent source of annoyance and perplexity. It took two men nearly half a day to fill them, on account of the smallness of the orifices, and the American cloth with which they were lined not only did not render them water-tight, but allowed of the water getting between it and the leather, thus rendering the process of emptying them a matter of difficulty.

Mr. Stuart bears a very pleasing testimony to the devotion of his party; and his diary often records his approbation, which he frequently

expressed by naming the various localities after one or other of his retinue. Few spots were of more importance to be specially designated than the water-holes and chains of ponds. Thus on the 2nd of May, the party arriving at a small water-course, with pools of water flowing into the plain, Mr. Stuart observes, "These ponds I name King's Ponds, in token of my approbation of his care and attention to the horses, and his readiness and care in executing all my orders." And this is no solitary instance: other springs were named in a similar manner, "Nash's Spring," "McGorerey's Ponds," "Auld's Chain of Ponds," "Frew's Water-hole," &c., &c., *in token of approbation.*

As might be expected in a country of such a nature, animal life is anything but abundant. Birds not unfrequently appeared in some numbers, but their kind is not always specified. In the neighbourhood of King's Ponds cockatoos were observed, and old tracks of the emu, but no quadruped game, except one wallaby and one kangaroo. The forest, it appears, grows dense and tangled, though no water be near, but in such situations not a bird was to be seen, nor the chirrup of any heard to disturb the gloomy silence. On Daly Waters, which cover a large area but are not deep, pelicans and other water-birds were observed; and the party here caught a number of small fish, from three to five inches long, something resembling a perch, which were looked upon as a godsend by men who had so long lived upon dry meat. In River Strangways, also, fine large fish were caught, some of them weighing 2½ lb. Of these some were of the perch family, and others resembled rock-cod, with three remarkable black spots on each side of their bodies. There were also some smaller ones resembling gold-fish, and other small ones, with black stripes on their sides, resembling pilot-fish.

The vegetable productions of the country vary according to the proximity to water. In a valley through which a stream of water runs, the sides are described as thickly wooded with tall stringy-bark, gums, and various kinds of palm-trees, which were very beautiful, the stems growing upwards of fifty feet high, and the leaves from eight to ten feet long, each side resembling an immense feather: a great number of these shooting out from the top of the high stems, and falling gracefully over, produced a very pretty, light, and elegant appearance. In other places dense scrub and impenetrable forest of gum-trees and tall mulgar, through which they in vain atttempted, by pushing, tearing, and winding, to make some progress, obliged them to make a circuitous journey. Such was that met with near Auld's chain of ponds. This, says Mr. Stuart, would be a fearful country for any one to be lost in, as there is nothing to guide them, and one cannot see more than 300 yards around. "Should any be so unfortunate as to be lost, it would be quite impossible to find them again; it would be imprudent to search for them, for by so doing the searchers would run the risk of being lost too." In such situations the usual resource of climbing a tree sometimes led to deceptive appearances of open country, caused by the shade of the sun on some of the lower mulgar bushes. Near Kewick's large group of springs, in lat. 13° 54′, on some table-land thickly planted with stringy bark, pines, and other trees and shrubs, the party for the first time saw the fan-palms, some of them growing

upwards of fifteen feet high. Again, at Anna's Creek, interspersed with marshy ground thick with trees, bushes, and strong vines, were plains covered with long grass, in this instance reaching to the shoulder of a man on horseback. Such grassy plains appear to be a very common feature, though the grass usually is not of such excessive height, reaching perhaps four feet, and offering sometimes great impediment to the progress of the horses from its dryness, which caused it to break and accumulate before their fore feet. But an inconvenience of a far graver character arose from the habit of the natives of setting fire to the grass. In many places the whole country was burned, and in one instance the explorers had a narrow escape. The country was in a blaze of fire to the east of them, but owing to there not being a breath of wind they were fortunately enabled to pass within a quarter of a mile of it.

No very striking flowers appear to have been met with except those of the bean-tree with bright crimson blossoms, a certain large creeper with yellow blossoms found on the banks of the River Strangways, and "a new kind of lily," evidently a species of Nelumbium, with flowers six inches high, resembling a tulip in form, and of a deep rose colour.

Considering how much the success of a former expedition was frustrated by the hostility and interference of the natives, it is not to be wondered at that Mr. Stuart was extremely wary of them on this occasion, and never sought their company. He was usually very successful in avoiding them, although it would appear that the country is by no means destitute of aboriginal inhabitants. Wherever they go they light a fire, and the smoke gave the travellers an announcement of their proximity. Native smokes seen in all directions is a not unfrequent remark of Mr. Stuart's diary, and it was obviously impossible under these circumstances to avoid them altogether. Accordingly, we have some account of the habits and appearance of this degraded type of mankind. In the neighbourhood of Frew's Water-hole they were visited by a few natives, who appeared to be very friendly; they called water (the great topic of conversation in the interior of Australia) "ninloo." These men were armed with spears, about ten feet long, which are described as having *sharp flint points* about six inches long, with a bamboo attached to the other end. They pointed to the west as the place where they got the bamboo, and the water also, but they appeared to have no knowledge of the country to the north. They were tall, well-made, elderly men, and went away quietly. A fire in the grass, which they ignited next day, almost surrounded and cut off the exploring party. On another occasion, Mr. Stuart, returning from an excursion, found a number of natives, old and young, hugging his men in the most friendly manner. Some pieces of white tape were given to them, which pleased them much. They still pointed to the west as the place where the large water was. On the banks of River Strangways, they came upon a spot where were numerous recent fires of the natives; there must have been a great many of them, for their fires covered the ground. Great numbers of shells of mussels were also found here—the remains of a feast upon those shell-fish. And in another spot they found a favourite camping-ground of the natives strewed with fish bones, mussel and turtle shells. Mr. Stuart seems to hint at cannibalism when he says, that on the place where the

natives had encamped a day or two before he saw the remains of bones of one of them which had been burnt; and he further describes an apparatus of poles stuck in the ground, making a framework about eight feet high, which he supposes to have been used by them *for smoke-drying a black-fellow*. This, he says, is a new feature in their customs. In many cases the natives ran off as fast as they could as soon as they saw the white men, yelling and squalling fearfully. On being overtaken, one of them held up a green bough as a flag of truce. A singular character was met with on the banks of Roper River. A number of natives being seen to approach the camp about sundown, preparations were made to receive them. They appeared friendly, however, and the attention of Mr. Stuart's party was attracted by an old man, whose legs are described as being about four feet long, and his body in all seven feet high, and so remarkably thin that he appeared to be a perfect shadow. A fish-hook in the hat of one of the whites attracted his attention, and making signs that he wished for it, it was given to him, at which he seemed delighted, and handed it over to his son, a short stout man, who was laughing all the time. But although apparently friendly, it was necessary to be ever on the watch, for they were not to be trusted. They would follow up the party during the night without being seen, though their tracks betrayed them in the morning. They will pretend the greatest friendship one moment, and spear you the next. The women are all small and very ugly.

Of course, in such an adventurous journey, the horses were most valuable auxiliaries, and their efficiency was watched with jealous care. Several mishaps occurred in connection with them. On the 11th of May the packhorse died, leaving them in a very awkward predicament. The want of water told upon the poor animals, and it was necessary sometimes to halt for two or three days to recruit their failing strength. One of the riding horses bolted into the forest, tearing his saddle all to pieces, but was recovered without further accident. On another occasion, one of the horses became bogged in a creek, and was with difficulty extricated; and another, less fortunate, was so completely fixed that in the endeavour to get him out the rope broke, and falling into water he was drowned. The carcase was extricated next day, and dried, and they all enjoyed a delightful change of diet. It was a great treat, "for the horse eats remarkably well, though not quite so good as bullock." Then their shoes came off, and the poor beasts were all lamed, till it was determined to stop and shoe their fore-feet with the shoes which were intended to be saved to take them back over the stony ground of S. Australia. At another time, a horse vanished during the night, and was not seen again. These and similar casualties must have been trying in the extreme to men whose lives depended upon the assistance of these valuable quadrupeds.

At length, on July 25th, everything combined to show Mr. Stuart that they were approaching the seacoast. "Stopped the horses to clear a way (through the belt of scrub fringing the beach) whilst I advanced a few yards on to the beach, and was gratified and delighted to behold the water of the Indian Ocean in Van Diemen's Gulf before the party with the horses knew anything of its proximity. Thring, who rode in advance of me, called out 'The sea!' which so took them all by surprise, that he had

to repeat the call before they fully understood, and then they gave three long and hearty cheers. I dipped my feet and washed my face and hands in the sea, and collected a few shells .... Thus have I through the instrumentality of Divine Providence been led to accomplish the great object of the expedition, and to take the whole party through, as witnesses to the fact, and through one of the finest countries man would wish to pass—good to the seacoast, with a stream of running water within half a mile of the sea. If this country is settled it will be one of the finest colonies under the Crown, suitable for the growth of any and everything. What a splendid country for producing cotton!" So having hoisted the Union Jack, and buried a record of the discovery at the foot of a tree on which their names were cut, they forthwith commenced the return journey.

This return was made over the same route. Many horses had been lost on the way, and thus the return was rendered proportionately difficult; but excepting some encounters with the natives, difficulties with respect to water, and such accidents, the journey presented nothing remarkable. Mr. Stuart himself, however, fell ill, and at one time scarcely expected to reach home alive. But early in January of the present year this gallant band did reach Adelaide, though Mr. Stuart was but in a weak state of health. Preparations were being made to give them an enthusiastic reception, for their fellow-colonists well know the difficulties of the exploration, and are able fully to appreciate the judgment and success with which it has been carried out.

SCIENTIFIC SUMMARY.

QUARTERLY RETROSPECT.

ASTRONOMY.

Solar and Lunar Eclipses.—A partial solar and total lunar eclipse—the former on the evening of May 17, and the latter on the night of June 1—have been favourably observed throughout the British Islands generally. The small portion of the solar surface eclipsed in the first (only 0·3 at London) produced little if any darkness or other phenomena, and observers could only notice the passage of the moon's disc over some of the spots, and the roughness of the moon's edges when projected on very strong light. The lunar eclipse was more interesting, and the gradual extinction of the moon's white light by umbra and penumbra, until only a dusky red patch was left in the sky, was more remarkable than any seen of late years. In some total eclipses of the moon it has been noticed that its surface is much brighter than on other occasions, and this has been held to be due to the distance of the moon from the earth at the time; *i. e.*, if the moon be at its shortest distance, the shadow (being larger) will more completely envelope the moon, and the latter be in consequence darker, and *vice versâ*. The moon was very near its perigee on the present occasion, so that the very considerable darkness observed may be taken as a further proof of this very natural explanation. The colour of the shadow on the moon was variable as the eclipse proceeded, being at first of an inky or greyish tint; but as the time of total eclipse approached, the hidden portion became gradually redder, the penumbra assuming a bluish colour, which is explained by the contrast between the red and light silvery part of the moon's disc; and the same effect was noticed as the shadow disappeared from the moon. The white spots on the floor of the mountain Plato were even conspicuous as the penumbra passed over that part. Another total eclipse of the moon will not be visible in England for some years, and it is but seldom that one is observed under such favourable circumstances.

Spectra of Stars.—Since Donati's memoir on this subject, published in the course of last year, it has engaged the attention of numerous observers; but the variety of detail seen by Secchi at the Roman Observatory (being probably favoured with a fine atmosphere at the time) is very remarkable, although, as yet, his determinations of the lines of only five stars have been published. Mr. Huggins and Dr. Miller have made a more extensive series on thirty or forty stars, and have been able to obtain microscopic photographs of Sirius and Capella. An ingenious method has been devised by

Mr. Huggins for observing the lines. He having found that the solar line D exactly corresponds with that of the sodium band, makes the latter the starting-point of his measures, having both it and the stellar spectrum which is to be examined, in the field at the same time. By these observations it is to be hoped that not only the chemical constitution but the temperature of the sun and stars may be determined, as it has been discovered that the length of the spectrum depends on the heat of the flame. M. Secchi makes use of Janssen's spectrometer of direct vision, and has been astonished at the magnificent results which he has obtained by it. In Alpha Orionis, he notices a line at F and four between F and G, only one of the latter of which is given by the Greenwich observations. The spectrum of Aldebaran extends still further, and sixteen lines of various breadths have been noticed in it. The spectra of Sirius and Rigel, which are white stars, are somewhat longer than those of the red stars, and the prominent lines appear in the blue and the violet, but are more rare in the less refrangible parts, with the exception of the red. It is remarkable, as Secchi observes, that the ray F is found in all the stars prominently as in the sun, and he considers its origin may be due to the terrestrial atmosphere. From the twenty stars observed at Greenwich, the majority give the same result; which is, however, equally well seen in the line G. There seem to be great anomalies in the different observations of spectra, which will doubtless be soon cleared away.

Companions to Bright Stars.—For some time past, observers have been endeavouring to detect faint stars in the immediate neighbourhood of bright ones, and have succeeded in many instances. Of those the companion of Sirius has been seen by the gigantic telescopes of Clark, Lassell, and Foucault. Latterly, M. Goldschmidt has not only succeeded in refinding it, but has also discovered five others, all of which are immerged in the light of Sirius, and one of them being nearly as close to the principal star as that discovered by Clark. MM. Barclay and Romberg have reobserved a small star close to Procyon, seen by Mr. Hind in 1855, and two other minute stars are noted, but their places not given. It would appear that some faint companions to Procyon have likewise been seen by M. Goldschmidt (*vide* "Les Mondes" of Feb.) Mr. Dawes says that one of the stars seen by M. Goldschmidt near Sirius is easily detected, but the five others could not be observed, and he thinks them *atmospheric* and not *telescopic* tests.

Mars.—Mr. Lassell has made a valuable series of drawings of the planet Mars, taken during the late opposition, and has arrived at some remarkable conclusions in respect to its organism. He finds that whilst the same phase occurs every thirty-nine days, and the planet should appear exactly the same, the seas and continents can rarely be certainly recognized from his drawings, and is therefore of opinion that "if the variously coloured portions do generally represent land and water, their aspect must be greatly modified by the transit of clouds of great extent, density, and variety of form." The white spot at the North Pole was smaller than that of the South Pole. The ruddy portion was more uniform in appearance than the blue or green part, the only distinct marking on the red being a curved streak near the South Pole. On Nov. 4, it was noticed that the

bluish portion had a very irregular and hard outline in its darkest part, like the coast-line of a terrestrial continent broken by bays and inlets. Delicate markings were visible on the red and brown parts. Where the white part is near the margin, there appeared to be a protuberance at that part.

Fringes of Light during Solar Eclipses.—The appearance of moving fringes of light seen on a whitened wall during the total eclipse of Dec. 31, 1861, is remembered to have been seen by M. Goldschmidt in the annular eclipse of Sep. 7, 1820. He perceived them fully two and a half minutes before the annulus was formed. He was walking at the time in a direction from east to west, when he saw the moving shadows coming towards him slowly. The movement was not rapid, and the aspect like the shadows of smoke in sunshine; the forms being rhomboids of four or six inches in diameter, mixed up with ribbon-shaped shadows. The inner spaces were filled with round spots mixing gradually with the other in grey transparence. M. Goldschmidt saw this strange apparition whilst he walked for about one hundred steps, when the annulus was suddenly formed, the light of the sun running round the moon like a fluid. At the eclipse of July, 1860, these spots, yellow in colour, were noticed by a Spanish countryman flitting over his white dress from west to east, and the fringes were also seen during the same eclipse by Captain Mannheim in Africa.

Motion of Sun in Space.—From a consideration of the proper motions of stars in space, Sir W. Herschel, Argelander, Galloway, &c., determined that the sun was moving in the direction of the constellation of Hercules; and Struve has even calculated its annual motion towards that point. The Astronomer Royal, however, from discussing a larger series of observations from 1,167 stars, doubted this conclusion; and Mr. Dunkin, by pursuing the same calculations, has arrived at the same result. It may be stated that Mr. Carrington and Professor Fearnley consider it hopeless to determine this problem by investigating it by the method which the former has pointed out—viz., as to whether the direction of the motion of comets before coming into solar influence was different from the concluded motion of the sun. Mr. Carrington, therefore, advises the persevering observation and determinations of proper motions.

Lunar Mountain Plato.—When the moon is full, and circumstances are favourable, by making use of a moderately sized telescope, two or three bright spots may be seen on the otherwise dark surface of the interior of Plato. It was not known whether these were pits, or elevations above the surface. On the evening of April 26, however, Mr. Dawes saw them to great advantage, and they were proved to be veritable craters or pits with elevated surrounding wall, which cast a shadow outwards on one side and inwards on the other. The other round spots were found to assume a similar appearance. There are some other bright spots and streaks which, however, Mr. Dawes considers neither elevated above nor depressed below the surface, like those bright patches which are seen at other parts of the moon. Some of the round spots are so small that it has been impossible to determine whether they are craters or not.

The Lunar Mare Imbrium.—Mr. Birt points out that between the S.W.

part of the Alps as far as Plato, the Mare Imbrium is of a pure dark colour, the uniformity of tint being very remarkable, and not interrupted with bright patches, craters, and roughnesses, as in the other seas.

Occultation of the Star Kappa Cancri on April 26.—Mr. Copeland (near Manchester), in observing the disappearance of this star at the moon's dark limb, noticed that there was an interruption of its light. At first about three-fourths of its light disappeared instantly, and in the interval of half a second the remainer disappeared. This would seem to show that the star was double. The occultation of the star Alpha Scorpii, which is only visible as double to the most powerful instruments presenting the same phenomenon at occultation by the moon, Mr. Dawes has consequently examined Kappa Cancri with the hope of detecting this duplicity, but although seen pretty favourably and examined with magnifying powers of 620 and 1,000, the star seemed perfectly round. Occultations of this star occur on September 9 and November 30 of this year—the latter will be the most favourable for observation. It may be stated, however, that Mr. Burr observed the disappearance of this star on the same night at Highbury, and says that the star disappeared instantaneously.

Sun's Parallax.—This important element—in other words, the distance of the earth from the sun—has been lately determined by Mr. Stone, from a comparison of simultaneous observations of Mars and stars near him, made at the Greenwich and the Victoria (Australia) Observatories. The result gives 8,932 seconds, differing but little from the value found by M. Le Verrier, but very considerably from that of 8,578 deduced from the celebrated transits of Venus of 1761 and 1769.

Deviation in the Direction of Gravity.—The observed co-latitude of the Observatory of Moscow has been found to be eight seconds greater than that given by the geodetic survey; and as there can be no doubt of the correctness of either, it clearly proves a local deviation. As there are no mountains in the neighbourhood, but it is a clear level country, this is the more extraordinary.

Dark Ring of Saturn.—On March 26, 1863, Mr. Carpenter found a great increase in the brightness of the dusky ring of Saturn, which appeared to be nearly as bright as the illuminated ring.

Glass Specula.—The Rev. Mr. Key has invented a new method of polishing the above, which from its success in the hands of amateurs promises excellent results. He polishes to a spherical figure first, and then modifies the figure of the polisher, with which, with the usual stroke and side-motion, he obtains the parabolic figure. By means of a $6\frac{1}{4}$-inch aperture, Mr. With, of Hereford, has worked one which separates the components of the small star of Gamma Andromedæ.

Parallax of Stars.—M. Krüger has determined the parallax of two new stars of which M. Argelander had established the considerable proper motion. The first is Lalande, 21,258, for which the annual parallax has been found to be 0·260 seconds of arc. The second is Argelander's star, 17·415–6, for which he finds almost the same amount—viz., 0·247 seconds. It is somewhat remarkable that both of those are stars invisible to the naked eye—the first being of the $8\frac{1}{2}$ and the second of the 9th magnitude. This would seem to show, which has already been established by 61

Cygni, that it is not the brightest stars which are always nearest to us; only one of the latter, Alpha Centauri, having a considerable parallax.

New Comets and Planets.—The second and third comets of 1863, discovered respectively by Klinkerfues and Respighi, were frequently observed during the months of April and May, but both became much fainter during the latter month. The first was a round nebula, which on April 20 was about 4′ of arc in diameter; the latter on April 26 was visible to the naked eye, with bright stellar nucleus, and a tail of a degree in length. The 78th planet, discovered by Dr. Luther on March 15 last, has received the name of Diana, and was of the 10th magnitude at that epoch. The planet (77) discovered by Peters in November last appears to have been unfortunate, and will with difficulty be refound, as no further observations have been taken, nor its elements computed. Another somewhat luckless planet (Leukothea) comes into opposition in November next, but will be of the last degree of faintness. M. Schubert, however, requests observers with proper means to pay particular attention to it, as he intends to investigate the mass of Jupiter by it—an important object, which shows the utility of even those little bodies.

Spots on Sun and Zodiacal Light.—Professor Wolf, whose labours in respect to the solar spots are so well known, gives further proofs of their periodicity, their relative numbers in the five years 1858—1862 being respectively 50·9; 96·4; 98·6; 77·4 and 59·4. He had previously determined the maximum for 1860-2, and has thence deduced the mean declination variation for Prague and Munich. The connection between the Solar Spots and Northern Lights has been likewise satisfactorily established, the period of the first, which recurs every eleven years, agreeing perfectly with that of the second.

Eta Argûs.—This celebrated variable star, which passes between the 4th and 1st magnitude, and at its latter phase being brighter than any of the stars of the southern hemisphere, has likewise been investigated by Professor Wolf. He finds a period of 46 years. In the curve of brightness given by him, it passes from the 4th magnitude to the $1\frac{1}{2}$ magnitude, then declines to the 2nd magnitude, after this increases to its greatest brightness in 23 years; six years subsequently falls to the 2nd magnitude; whence in five years time it rises to $1\frac{1}{2}$ magnitude, and then decreases to the 4th magnitude.

Jupiter's Satellites and the Pleiades.—It has frequently been argued whether Jupiter's satellites are visible to the naked eye, and equally so as to the number of stars in the Pleiades visible under those circumstances. A member of the Astronomer Royal's family instead of the ordinary six always sees seven, and in favourable weather as many as twelve, and this has been verified by actual mapping. Mr. Mason, on April 15, after gazing with great care at Jupiter, and taking every precaution, detected a luminous point close to the planet which was altogether independent of the radiations, and on looking through his telescope found the satellites clustered at the point which he had previously noticed.

BOTANY.

The Calabar Poison Bean (*Physostigma venenosum*).—The seed of this plant has lately been much noticed for the medicinal properties which reside in it. The most energetic results are obtained from the kernel. These are chiefly marked upon the spinal cord, producing muscular paralysis. When applied locally to the eyeball or eyelids, destruction of the contractility of muscular fibre, and contraction of the pupil result. This property is advantageously employed by the oculist.

Cultivation of Cinchona Trees in India.—Dr. Anderson, Superintendent of the Calcutta Botanic Garden, is inspecting the introduction of Cinchona into the Sikkim Himalayas. His nursery is reported to be in a most flourishing condition, and he has seven species under cultivation. He states that it promises to be a most successful experiment on those moist hills.

Iron as a Tonic in the Vegetable Creation.—It is alleged that a discovery of a curious kind has been made regarding the influence of iron on vegetation. On chalky soils where there is an absence of iron, vegetation has a sere and blanched appearance. This is entirely removed, it is said, by the application of a solution of sulphate of iron. Haricot beans watered with this substance acquired an additional weight of 60 per cent. It is expected that the salts of iron will be found as beneficial in farming as in horticulture, but the experiments are yet very incomplete. In the cultivation of clover, wonderful advantages are declared to have been gained. The material is cheap and the quantity applied is small.

The Flora of Australia.—Dr. Murray, who accompanied Mr. Howitt's expedition as medical officer, has brought back specimens of timber representing seventeen species of trees, the most peculiar of which have received the name of the cork tree, and the orange tree. The fruit of the latter in outward appearance is not unlike a small orange, but it has a pungent flavour, which renders it disagreeable to Europeans, being something between a water-melon and cayenne pepper. The collection of timber, made with great labour, has been sent to Dr. Müller for examination.

The Receptacles of the Juices of Plants.—M. Lestiboudois endeavours to dispel the doubt respecting the existence and nature of latex and laticiferous vessels. He propounds a series of questions, which he answers as the result of his researches. The coloured juices of plants do not resemble (according to this botanist) a fluid which has to furnish organs with the materials of growth, either in their physical properties, in their composition, or in the situations in which they are found. In some plants the reservoirs of the coloured juices constitute a vascular system, so disposed as to follow the vesication of the leaves, and appertaining more particularly to the cortical structure of the stem. The proper juices are more dense, and of a deeper colour in the lower and older parts of the plant, and usually are nearly absent from the root ; but in some instances (as *Lactuca sativa*) abound there. The *vasa propria* are, as a rule, distinguishable from neighbouring tissues by the colour of their contents, and by their flexuous, thin, branching, and anastomatic form.

Darnel Grass.—M. Filhol has recently investigated the toxical properties of the *Solium temulentum.* Numerous experiments have been at different times made on animals with this plant; but they have not hitherto led to anything certain concerning the nature of the poison contained in it. M. Filhol has discovered that it contains a double poison—a poison of the strychnine class, and one of the narcotic kind. He has isolated these two poisons, and experiments on animals have shown their special actions, and explained their contradictory effects. M. Filhol adds, that the presence of *Solium* in corn may be shown by the shape of its starchy particles, which are different from that of wheat.

Vascular Bundles in Ferns.—Mr. Church, in a paper published by the Linnæan Society, lays great stress upon the arrangement of these bundles, and from several hundred observations, deduces that there is no marked distinction between the genus *Polystichum* and the genus *Loppodium* (*Lastrea M.*) in this particular. Foreign specimens bear out this result. Also that the genus *Lastrea* (of Moore) contains two British species, and many foreign ones, which possess a totally different arrangement of their vascular tissue, and that this fact, taken in connection with the previously recognized differences of these *very same* species, almost warrants their removal to another genus. And, lastly, that genera whose outward characteristics are conspicuously distinct, exhibit marked differences in the arrangement of their vascular fasciculi, which closely allied genera do not.

Parthenogenesis of Alberia Caffra.—Dr. Anderson, of the Calcutta Botanical Gardens, mentions that this plant, a thorny bush, had been in the gardens some years without producing flowers. It contains pistils only, being dicœcious. In March, 1861, it bore a large crop of well-ripened fruit, which was sown, and gave rise to a vigorous stock of young plants. In February, 1862, it flowered again, and the most careful examination led to the detection of no trace of stamens. This tree was unfortunately destroyed a few months ago in a severe gale; but a second specimen artificially propagated from the first still exists in the gardens. It has never flowered.

Sarracenia Purpurea.—This pitcher plant has of late been brought into prominent notice from its supposed virtues in cases of smallpox. Numerous experiments have been made upon its properties, with very various results; some practitioners praising it highly, while others have been disappointed. No doubt that many important discoveries remain to be made in vegetable *materia medica;* but the utmost caution is necessary, lest a hasty conclusion should retard, instead of advancing, the subject.

CHEMISTRY.

MR. MARKHAM, who a few years ago was appointed the superintendent of an expedition for the collection of cinchona plants and seeds, and for their introduction into India, has lately read a paper on this subject before the Society of Arts. Although the difficulties that presented themselves were very great, they have been so effectually met that there are

now growing in the Neilgherry Hills and in other parts of India about 130,000 cinchona plants of the most valuable species, the result of the labour bestowed upon the subject.

The greatness of the work will at once be appreciated if it is remembered that the cinchona plant had not yet been cultivated, that its conditions of growth were unknown, that it is found in forests scarcely ever visited by Europeans, and that great care was required in the selection of the species. Mr. Markham, in the prosecution of this undertaking, pointed out the distinction between mere transplantation and that true cultivation which consists in placing the plant in circumstances favourable to its development, and removing hurtful influences.

The importance of the cultivation of this plant cannot be overlooked when the immense medicinal value of quinine, and its present scarcity and high price, are considered. Already, specimens of the bark from these cultivated cinchonas have been analyzed by Messrs. Howard & Sons, who report that they contain as good a per-centage of quinine as the cinchonas from which they have hitherto been in the habit of extracting that alkaloid.

Mr. Lewis Thompson, M.R.C.S., has been making some experiments on nickel with respect to its preparation in a state of purity. He considers that the large quantity of arsenic employed in the manufacture of nickel, and which is very prejudicial to health, is quite unnecessary; for by first roasting the ore, and then heating it with half its weight of chalk, he succeeded in obtaining a rough metal containing 88 per cent. of pure nickel, the rest being cobalt and iron, with a little sulphur, but no arsenic; this metal being decidedly more pure than the ordinary commercial nickel. He proposes, as a method for the analytical separation of nickel and cobalt from other metals, the addition to the warm solution of the mixed sulphates of nickel, cobalt, manganese, iron, copper, &c., of as much sulphate of ammonia as the liquid will dissolve, and to set the solution aside to cool, when almost every particle of nickel and cobalt will separate as double sulphates of nickel and of cobalt with sulphate of ammonia.

The new metal thallium has attracted considerable notice for some time past. From a lecture given by its discoverer, Mr. Crookes, at the Royal Institution, we gather the following particulars concerning this metal :—

The property by which its discovery was effected was that of giving a single brilliant green line when examined by means of the spectroscope. Mr. Crookes was engaged in examining the residue from a manufactory at Tilkerode, in the Hartz, for the purpose of extracting the selenium from it. This was effected in the ordinary way, and the crude selenium was distilled. A considerable residuum was left behind in this operation, in which he suspected the presence of tellurium. Some time afterwards, happening to require some tellurium, he examined this residue more minutely, but without getting definite results; the chemical tests appearing to give contradictory evidence. Recourse was then had to spectrum analysis, when a remarkable green line was observed to cross the field of view. This convinced him that a hitherto unrecognized element was present, and he set himself to the task of isolating it. At first he inclined to the belief that he had a metalloid, or semi-metal, to deal with; but having

obtained an additional supply of material, he was enabled to precipitate the substance from solution, by means of zinc, in the form of a black powder, and to obtain it in distinct metallic crystals by voltaic deposition, which removed all doubt as to its metallic nature. It may be as well to remark, in vindication of Mr. Crookes's claim to the priority in the discovery of this metal, that he obtained these metallic crystals in September, 1861.

To obtain the metal in a coherent form, it is only necessary to squeeze the precipitated mass together, and fuse it under cyanide of potassium, or simply to submit it to powerful pressure, when, from its great softness, it will unite into one mass.

Spectrum analysis furnishing an easy method for the detection of the new metal, Mr. Crookes has discovered its existence in varying proportions in many specimens of pyrites, sulphur, sulphide of cadmium, metallic cadmium, and zinc; also in copper and in bismuth ores. A specimen of native sulphur from Lipari was found to contain so much thallium that it might almost be classed as a new mineral.

Thallium is extracted from pyrites by distilling the sulphur from it, the thallium passing away at the same time; the thalliferous sulphur is then boiled with potash, and the black residue heated with sulphuric acid; the solution is then filtered, and hydrochloric acid added to the filtrate, when the difficultly-soluble protochloride of thallium is precipitated; this is filtered off, washed, and converted into sulphate; the solution of the sulphate is then decomposed by means of the voltaic battery.

The chief characteristics of thallium are as follows: It is a white opaque metal, with a perfect metallic lustre; its specific gravity is 11·19; it is very malleable, and may be rolled into leaves as thin as tissue-paper; it is not very ductile, and can only with difficulty be drawn into wire, but, by means of pressure, thallium-wire can be made with great ease. The metal also possesses the singular property of compressibility, and it is the softest known heavy metal, being exceeded in this respect only by the metals of the alkalies. Thallium marks paper like plumbago; the mark fades out from oxidation in a short time, but it may be again rendered visible by moistening the paper with a solution of sulphide of ammonium; with the exception of bismuth it is the most diamagnetic metal known. Thallium melts at 550° Fahrenheit; at a full red heat it may be distilled; it burns in oxygen, and tarnishes very quickly in the air, becoming coated with an oxide which is tolerably soluble in water; the oxide may be rendered anhydrous at the ordinary temperature in a vacuum. The metal dissolves in acids, the proper solvent being nitric acid; it forms at least two basic oxides; the protochloride, like chloride of lead, is slightly soluble in water; bichloride of platinum produces an insoluble double salt with chloride of thallium; sulphuretted hydrogen produces no precipitate in an acid solution; sulphide of ammonium, a black precipitate of sulphide of thallium; on adding ammonia to a solution of the sesquichloride, a brown peroxide is produced, together with protochloride of thallium. In one or two of the properties here alluded to, thallium approaches the metals of the alkalies, but the great majority of its characteristics point out that its true position is by the side of silver and lead.

The decomposition of chlorate of potash in the presence of oxides of manganese and copper has been studied by M. Wiederhold. He found that, contrary to M. Schönbein's hypothesis, oxygenated bodies are not the only ones capable of determining the decomposition, for that spongy platinum had the same power. A rise of temperature was found to take place in the mixture as soon as the bath in which the retort was placed had reached a temperature of 250° for the mixture of chlorate and peroxide of manganese, and 290° for the mixture with oxide of copper. Oxygen began to be given off at temperatures varying from 200° to 285°, according to the mixture employed.

M. St. Clair Deville has made some interesting discoveries connected with the decomposition of bodies by heat. On passing a current of hydrogen through a porous earthen tube, it diffuses so rapidly that the gas which issues from the other end of the tube will be found to be not hydrogen but air. If the porous tube is surrounded by a larger and shorter tube of glazed porcelain into which carbonic acid is passed at one end, the two gases will be found to have changed places by the time they reach the other end of the two tubes.

When these tubes are heated to a temperature of 1,100° to 1,300° C., and a current of steam passed through the inner one, while a carbonic acid is passed through the outer tube, the gas collected consists of hydrogen and oxygen, mixed with carbonic acid.

M. Deville considers the decomposition of a substance to be in all respects analogous to the ebullition of a liquid; water is completely decomposed at a temperature sufficient to expand the vapour to tenfold its volume at 0° C. The decomposition can also take place at lower temperatures, the phenomenon being in this respect analogous to that of the evaporation of liquids below their boiling points. M. Deville has also extended his observations to the dissociation of carbonic acid by means of heat.

GEOLOGY AND PALÆONTOLOGY.

PROFESSOR RAMSAY has discussed the significance of the physical breaks and changes of life in the several strata of the Palæozoic system. When he finds that strata have been upheaved, denuded, and had other rocks deposited upon them, he concludes that we here have evidence of an extremely long interval of time unrepresented by any deposit, the vast duration of which may be computed by noticing that the physical break is always accompanied by a change in the life; hence, also, he supposes that a change in the life probably indicates a physical break. From the Lauvention rocks to the top of the Silurians are six of these cases of nonconformity; in the Old Red Sandstone, two; in the Carboniferous strata, one; and one between the Carboniferous and Peruvian; ten in all. Now, in no one of these strata is the duration so long that from bottom to the top all the species change; yet in the breaks one commonly finds that not only have the species but most of the genera disappeared,

and been replaced by new forms. The Professor therefore concludes that the Palæozoic *time*, of which we have no record, must be regarded as far longer than that represented by the whole series of known Palæozoic rocks.

Mr. Carter has described the skull of a *Bos primigenius*, from the peat of Reach, in Cambridgeshire, offering more satisfactory evidence than anything hitherto known of the co-existence in England of man with the supposed ancestor of our domestic cattle. The skull was found beneath 7 feet of peat, and with it most of the skeleton, though there were few limb bones, and not many ribs. It was brought to Cambridge, still much covered with peat, and sold. The investing matter was duly removed, and then became visible a chipped stone celt driven far into the skull, and broken off level with the frontal bone. The fracture was old, the flint was old, the bone around it was depressed, and the weapon, which passed obliquely through the sphenoid into the orbit, penetrating the brain-cavity for three inches, was firmly wedged in the skull. The flint appeared to have been one of those elongated narrow forms with sub-parallel sides which are supposed to have been unknown in the earlier Stone age. It was conjectured that the tool had been lashed to a pole, and so used, when the ox was running, to deliver the blow which, from being accidentally oblique, has from its violence snapped the celt. Mr. Carter did not regard the specimen as bearing on the antiquity of our species, and thought it rather an evidence that the beast lived to very modern times than that man was an ancient denizen of the land. This is an echo of the idea broached by Mr. Prestwich on the chipped flints from the gravel, and cannot be received with too great caution, for the facts of the case are these:

Here in the peat of the Bedford Level are found *Bos primigenius*, *Bos frontosus*, *Cervus Hibernicus*, and *Bos longifrons*, all of which are extinct; the last species going for little, since it frequently occurs in Roman graves. The existing species are not animals now common in the country, and must all be regarded as becoming extinct; among them are the brown bear, the wolf, otter, beaver, wild hog, roebuck, red deer, &c., altogether not more than twelve. Now, when one-fourth of a fauna has died out, and the remainder, even though for obvious reasons, disappeared, it cannot but be supposed that the change indicates a remote antiquity for the stratum in which their remains are entombed. Had the skull been an ordinary one, unassociated with human work, beyond question this antiquity would never have been doubted; and, therefore, the legitimate conclusion from a specimen like this seems to be, that in the days of the *Irish Elk*, beef was already the food of a Briton, courageous and skilful enough to hunt and slaughter the most formidable beast of his time.

Professor Harkness has written elaborately on the Skiddaw slates, tracing their features through the Lake district. He estimates their average thickness in the North of England at 7,000 feet. The mineral character varies so much from place to place as to be worthless for division of the deposit into subordinate groups. From both fossil and physical features the Professor regards the Skiddaw slates as of Llandeill age. These strata appear to be the metropolis of the graptolites, and yield to

the collector a number of new radiating and branching forms, which are referred to the genera Phyllograptus, Tetragrapsus, Dichograpsus, &c.

Professor Rupert Jones publishes a monograph of the Estheriæ, crustaceous creatures with a carapace in two pieces, so like bivalve shells that they have been referred to as such by the best authorities. The living forms all inhabit ponds and fresh water, being rarely found in marshes or near the sea. There are fourteen fossil species, ranging from the Old Red Sandstone to the most recent strata. The existing forms being all fresh water, it is thought likely that the same distribution held good for the fossils, and hence that they offer strong suggestive evidence that the fishes of the Old Red Sandstone, like their existing allies, had fresh water habits.

The Rev. O. Fisher has described a bed of peat near Colchester which contains the bones of *Elephas primigenius*. It rests on stratified gravel and is overlaid by brick-earth. This peat contains the remains of insects differing from British existing species, and from their brilliant colours, &c., are thought to have their nearest affinities with those of tropical countries.

Mr. Fergusson has chronicled the recent changes in the Delta of the Ganges. In early historical times, the plains of Bengal were drained by the Brahmapootra passing to the sea by Goalparah, and the Ganges which, passing Rajmahal, ran parallel to it. Then came the upheaval of the Modopore jungle, north of Dacca, producing a depression known as the Sylhet Jheels, into which the Brahmapootra was diverted by the upheaval. The Jheels were gradually filled up, and in the beginning of this century the river returned to its former bed. The result of this was that all the rivers of the western half of the Delta were re-opened, and should the present drainage continue, the two great rivers promise to resume very nearly the courses held before the disturbance. He thinks there is sufficient historical evidence to demonstrate that 5,000 years ago the fruitful rice plains of Bengal were a jungly swamp, with only a few spots on the larger rivers which were inhabitable and capable of cultivation.

MEDICINE, SURGERY, THERAPEUTICS.

MEDICINE.

Diseases of the Liver.—Two very important works on the diseases of the liver have very recently been added to the medical literature of the country; they both contain some new and really scientific observations, based upon studies in physiological chemistry, and are calculated to be of service to the medical profession. One work is the "Clinical Treatise on Diseases of the Liver," by Dr. Freid. Theod. Frerichs, translated by Dr. Murchison for the New Sydenham Society. The other work is entitled "Jaundice: its Pathology and Treatment," by Dr. George Harley, of University College.

It may not be amiss to inform our non-professional readers, that since 1853 it has been known that the liver performs another function

besides that of secreting the bile. This organ is also concerned in the formation of a sugar, an amyloid or a starchy principle, the true conditions and pathological relations connected with which are not at present fully known; but it is not discharged like bile into the intestines,—it is taken up by the veins in the liver, conveyed into the general circulation, and becomes subservient to the processes of respiration and nutrition. The liver has therefore two distinct functions, the formation of bile and that of sugar. The latter is called the glycogenic function.

The works of these two authors may be said to represent the latest news on the pathology of certain forms of jaundice; the true theory and explanation of which is yet by no means ascertained. Without attempting to go into a review of these works, we simply recommend them to the favourable notice of the public and to the medical profession as the best standard scientific and practical treatises on liver diseases. The treatment of jaundice and its diagnosis in the work of Dr. Harley shows the great advantages that physiological chemistry offers to explain difficulties, and guide the practitioner in his views of treatment.

The Laryngoscope.—The application of this new instrument (referred to in "Popular Science Review," page 281), invented for examining diseases of the vocal organs, is becoming daily more popular and better known.

Dr. George Johnson read a paper upon the laryngoscope before the London Medical Society in April; Dr. George Gibb lectured before the *élite* of the musical world, at the Musical Society of London; and Dr. Sieveking read a paper before the members of the Harveian Society, each illustrating his discourse by cases and observations. Professor Czermak, the inventor, who is now visiting this country (June 9), gave a clinical demonstration last week at University College Hospital.

The detection of obscure or unsuspected disease is a fact of great value in the diagnosis and treatment, which in the hands of skilful men will reward their labour in this field of research.

Resuscitation and Restoration (of Suspended Animation) from Drowning.—The last volume (xlv.) of the "Medico-Chirurgical Transactions," contains the report of the committee appointed to investigate the subject of suspended animation.* A large number of experiments upon animals, and on the dead body, the result of which are of such importance as to deserve a notice, tend to modify the previously adopted plans for the restoration of persons asphyxiated from drowning.

The method of Dr. Marshall Hall, usually called the postural or ready method, consists essentially "in turning the body round gently on one side, and a little beyond, and then briskly on the face, alternately," making pressure along the back of the chest each time the body is brought into the prone position. Up to the present time this is generally considered the best plan that could be adopted to expel and introduce air into the respiratory cavities or lungs, but no definite information was given as the result of

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* The members of this committee were: C. J. B. Williams, M.D., F.R.S.; C. E. Brown-Sequard, M.D., F.R.S.; George Harley, M.D.; W. S. Kirkes, M.D.; Hyde Salter, M.D., F.R.S.; J. B. Sanderson, M.D.; W. S. Savory, F.R.S.; E. H. Sieveking, M.D.

observation and experiments. The committee has undertaken to do this in a very elaborate series of experiments on the dead subject, and it has now fully determined the best method of introducing air into the lungs. The method of restoring the action of the lungs in cases of drowning, introduced last year by Dr. Silvester, may now be considered to be satisfactorily proved to be the best known.

The volume of air inspired, as found upon actual measurement, in Dr. M. Hall's plan "to imitate respiration," varied much, from a few cubic inches to 8 or 10 inches, but never exceeding 15 cubic inches. In Dr. Silvester's plan it was found, on extending the arms upwards, a volume of air was inspired into the chest which varied from 9 to 44 cubic inches, and by bringing down the patient's arms gently, and firmly pressing them against the sides of the chest, so as to diminish the cavity of the thorax, and by alternating these movements, a regular exchange of air was produced, the quantity of which in several instances exceeded 30 cubic inches, and in one instance amounted to 50 cubic inches.

The committee recommends that the plan of Dr. Silvester should be employed in the following manner:—

The body laid on its back (on a flat surface, or a plane slightly inclined from the feet upwards), a firm cushion placed under the shoulders, the head kept in a line with the trunk. The tongue should be drawn forward so as to project a little from the side of the mouth; then the arms should be drawn upwards, until they nearly meet above the head, the operator grasping them just above the elbows, and then at once lowered and replaced at the side. This should be immediately followed by moderate pressure, with both hands, upon the lower part of the sternum. This process is to be repeated about twelve or fourteen times in the minute. As regards facility of application, the plan recommended by Dr. Silvester is equally or perhaps more effective than the Marshall Hall plan.

OPHTHALMIC SURGERY.

Atropine Paper.—Mr. Streatfield has just introduced a portable and convenient substitute for the solution of atropine in ordinary use. He has used green tissue-paper which has been steeped and dried with the solution of atropine, so that one-fifth of a square inch contains enough atropine to dilate the pupil. The small piece of paper is wetted and placed under the lower eyelid, where it causes no pain or inconvenience for the short time required to dilate the pupil. In many cases this small scrap of paper has been found to cause less irritation than the drops of the solution of sulphate of atropine in general use.

The Ophthalmoscope.—A binocular ophthalmoscope has been invented by Mr. Carter, formerly of the Kent County Ophthalmic Hospital. The "Ophthalmoscopic Atlas" of Liebreich is a valuable addition to ophthalmic surgery; it contains twelve well-executed plates, indicating the most interesting appearances in those parts of the eye which have hitherto been recognized by the best observers in the new science of ophthalmoscopy.

The Calabar Bean.—During the last few weeks observations have been going on in some of the London and provincial hospitals to test the properties of the Calabar or ordeal bean in ophthalmic surgery.

This bean, known as the ordeal bean of Calabar, is a very rare plant of the leguminous order, grown only in the King's garden. It was introduced to Dr. Christison some years ago by a missionary named Waddel. Dr. Christison described certain poisonous properties peculiar to it, in the "Pharmaceutical Journal," ten or twelve years back; but the special properties in producing a contraction of the pupil have only recently attracted the attention of ophthalmic surgeons. Dr. Argyle Robertson, Dr. Frazer, Dr. George Harley, Mr. L. Woolcott, Mr. Selberg Wells, all concur in proving it to be of some value in ophthalmic practice, as an anti-medreatic or contractor of the pupil. Its physiological effects are apparently directly opposed to those of belladonna. It may thus counteract the disagreeable and frequently too prolonged action of the solution of atropine in ordinary use in dilating the pupil previous to, and for assisting in, ophthalmoscopic examination.

Mr. J. Woolcott, of the Kent County Ophthalmic Hospital, one of the earliest observers in England, will shortly publish his cases, and it is hoped will confirm the facts by cases and observations.

MATERIA MEDICA AND THERAPEUTICS.

The "New Pharmacopœia."—The "New Pharmacopœia"—that is, the "British Pharmacopœia"—is now almost ready for publication, the proof-sheets having been laid before the General Medical Council. The labour upon this work is immense; it has occupied for some years gentlemen associated with the Edinburgh, Dublin, and London Colleges of Physicians, and with other learned bodies connected with pharmacy. Professor Garrod is the secretary to their committee. This work will form what has long been wanted—a truly national pharmacopœia.

The President of the Pharmaceutical Society, Peter Squire, F.L.S., &c., has just published a work called the "Pharmacopœia of Thirteen of the London Hospitals." It is so arranged in groups for easy comparison with the formulæ of various hospitals, that in future it will be interesting to compare them with the forthcoming work above mentioned, to which it will form a most valuable supplement.

Quinine in India.—To those persons who are watching with interest the growth of quinine in India, it will be gratifying to know that quinine and the other alkaloids known as tonics and useful for their febrifuge properties, have been extracted from the barks of the cinchonas of two years' growth from the Neilgherry Hills. It has been found that the per-centage of quinine, cinchonidine, and cinchonine is as great as can be obtained from the bark of the South American produce.*

Anæsthetics.—As an anæsthetic, chloroform has not yet fully satisfied the expectations of the profession. A committee of some of the members of the Medico-Chirurgical Society has been appointed, and is now actively engaged in experimental inquiries as to the uses, effects, and best modes of administering chloroform. The main object which the committee has in view, is to inquire not only into the practice of employing chloroform by inhalation for surgical operations and in midwifery practice, but to ascertain its

* See also Chemical Summary.

results in the treatment of many diseases, such as tetanus, delirium tremens, asthma, epilepsy, hysteria, infantile convulsions, &c.

Flame-proof or Non-Inflammable Fabrics.—The frequency of accidental death by burning, more especially since crinolines have been in fashion, has given rise to experiments in this country and in France to determine the best means of rendering dresses flame-proof. The most recent researches are by Westerman and Oppenheim, which show that solutions of the salts of sulphate of ammonia, phosphate of ammonia, and tungstate of soda, are those that can be used with greatest facility. For rendering tissues uninflammable these salts combine the conditions of cheapness, and harmlessness to the gloss, colour, and structure of the tissue. The solution may be used in the proportion of one-third the weight of starch, or from 15 to 20 per cent of water. The tungstate of soda appears to have the advantage of the two other preparations, for with starch it forms a better stiffening, and is less liable to be decomposed by the smoothing iron.

Permanganate of Potash as a Deodorizer.—It cannot be too well known that the permanganate of potash is one of the best disinfecting and deodorizing liquids in use. Half a drachm to eight ounces of distilled water are the proportions in which it may be used. It is far superior to any of the chlorine preparations—not so transient in its effects. Suppurating sores, offensive discharges from wounds, ulcers, &c., the removal of bad smells from the nose, breath, and feet, or from carious teeth, and for post-mortem examinations, &c., are some of the more prominent uses to which this solution has been recently applied.

A New Disinfectant.—Charcoal, which has been long known for its antiseptic properties, is now ingeniously used in the form of charcoal paper, or charcoal lint. The carboniferous paper may be applied to ulcerated surfaces, to absorb and at the same time deodorize the liquid discharges, thus preventing the bed from being soiled. The carboniferous paper may be applied to indolent ulcers with good effect. Messrs. Maw & Sons, in London, are agents for the French inventors of this novel preparation of charcoal.

The Ergot of Wheat.—The ergot of wheat may be used as a substitute for the ergot of rye, and possesses some advantages over it. M. Laperdriel, of the College of Pharmacy of Montpellier, has read a paper on this subject, in which he points out the fact that ergot of wheat has all the medicinal properties of the ergot of rye, with the advantage of resisting decay and moisture, hence may be preserved a long time. The ergot of rye is well known to be easily damaged by damp air, and is soon destroyed by mites.

Galvanism as a Remedial Agent.—Mr. Harry Lobb, surgeon to the London Galvanic Hospital, read a paper before the Harveian Society on the uses and value of galvanism and electricity in general practice. As a therapeutic agent, galvanism promises some good results, although they are not yet fully recognized in the profession, but which Mr. Lobb has full confidence will at no distant period be as familiar to every well-educated practitioner in the treatment of disease, as is now the administration of drugs. The judicious administration of galvanism has

produced results in the treatment of disease that remain no longer to be doubted.

MISCELLANEOUS.

Poisonous Mushrooms.—The Academy of Medicine in Paris proposes to offer again, in 1864, the Orfila Prize of £160 for the best essay on poisonous mushrooms. Last year three unsuccessful competitors were in the field. The points for inquiry are the following: Give their characters, especially such as may be generally appreciated; examine what effects are produced upon the poisonous or eatable qualities by cultivation, climate, seasons, soil, or exposure; how to separate their toxical principles; indicate their physical and chemical properties; show the means of detecting their presence in cases of poisoning; examine whether the poisonous principle can be separated, and the means of procuring this; its action upon the organism, and the remedies that would be opposed to it.

Cottage Hospitals.—These useful institutions, many of which have been established in different parts of the country during the last three years, continue to flourish. The reports that are issued give encouragement for their foundation in other localities, where the poor are very liable to severe accidents, as in some of the mining districts.

Cranley Village Hospital has six beds; thirty patients were admitted last year, and were treated at a cost of £176. 8s. 2d., leaving a balance of income of £49. 6s. 11d. in hand. Each patient cost £5. 17s. 4d.; the maintenance of each bed about £30 per annum. Each patient was under treatment for an average period of two months; and the report shows that a weekly contribution of 3s. 6d. for each patient is almost enough *to find food and drugs.*

The Water of the Thames.—The question of the purification of the Thames is yet by no means settled; indeed, without some further inquiries and legislation, it may possibly turn out to be a gigantic failure. The District Board of Works of Fulham has memorialized the Metropolitan Board of Works, and made objections to the plan which has been proposed by their Board of deodorizing 9,500,000 gallons daily of the sewage of the western districts of the metropolis at Land's End, Fulham, and casting it into the Thames.

Dr. Letheby has recently issued a report on the waters of the Thames, in which he points out many facts of great value. He finds the middle of the river is invariably charged with a larger proportion of soluble matters than the water near the shores. The saline matters vary from 32 to 100 grains in the gallon; and in certain summer and autumn months, when the evaporation is greatest, it reaches even to 150 grains in the gallon. He finds that when, from a diminished rainfall, the supply of water in the river is mainly from the sea, the mixture of sewage water with the sea water gives rise to a very unpleasant odour and very offensive decomposition. The suspended matters in the water of the river are much increased at the time of the equinoxes. These investigations of Dr. Letheby are worthy of attention in relation to the main-drainage scheme. They show that at certain times of the year the discharge of sewage at Barking Creek will again return with the upward tidal current, and may be prejudicial or dangerous to health from the surface evaporation of so large a bulk of

water in constant agitation. The public, the medical profession, and sanitarians generally ought to watch the proceedings of any board entrusted with such vital interests.

MICROSCOPY.

Structure of the Valves of Pleurosigma.—Dr. Wallich calls attention to the error into which most observers have fallen, in supposing that the diagonal and rectangular series of lines (as the case may be) constitute the portions of the valves which, under the high magnifying powers of the microscope, become convertible into the so-termed *dots*, *beads*, or *hexagons* —the fact being (he says) that the *striæ* seen under the lower powers, if properly exhibited, are never convertible into anything but lines, whereas the dots, beads, and hexagons are the imperfect expositions of the structure occurring in the spaces included between the intersections of those lines. Dr. Wallich always prefers oblique light for the examination, and by its use he concludes that he has ascertained beyond question that the marking on *P. angulatum*, *balticum*, &c., is produced by *pyramidal* sharp faces, and finely acuminate elevations on the surface. He is of opinion that the intervening spaces in *P. angulatum* and its allies exhibit elevations, but thinks it probable that the corresponding spots on *P. hippocampus* are occupied by depressions. Dr. Wallich's paper in the "Annals of Natural History" for May, enters very fully into the debated subject, and is worth consulting.

Fermentation produced by Infusoria.—M. Pasteur, in the "Comptes Rendus," confirms a statement laid before the Academy two years since, that there exist infusory animalcules possessing the two properties of living without free oxygen, and of acting as ferments. The new example adduced is the fermentation of tartrate of lime, determined by the presence of an infusory animalcule, existing without free oxygen, and belonging, like that which determines the butyric fermentation, to the genus *Vibro*. He promises to demonstrate in a future communication that there are other animalcule ferments of putrefaction under exposure to air, which are found associated with infusoria, or mucors, that consume the free oxygen, and fulfil the double purpose of agents of combustion with reference to the organic material, and of agents of preservation for the infusoria ferments, by protecting them from the contact of the ozygen of the air.

The Formation of Infusoria.—Professor Wyman, of Harvard College, has made a series of experiments of a most interesting character, in which the results of Pasteur have been in a great measure negatived. Living organisms made their appearance in many instances where even greater precautions were taken than those mentioned by the French observer. In Wyman's experiments, solutions of organic matter, some of them previously filtered, have been boiled at the *ordinary pressure* of the atmosphere for a length of time varying from fifteen minutes to two hours, and exposed to air purified by heat. In four instances the contents of the flasks were unchanged at the time they were opened; but in all the rest Vibrios, Bacteriums, and other organisms appeared. In nearly every

instance their presence was indicated, in the early stage of the experiments, by the formation of a film, which took place in some on the second, and in others not till the nineteenth day. The result of the thirty-seven experiments is, that the boiled solutions of organic matter made use of, exposed only to air which has passed through tubes heated to redness, or enclosed with air in hermetically sealed vessels, and exposed to boiling water, became the seat of infusorial life.

The Microscope in Meteorology.—Mr. Sorby has turned the microscope upon meteorites, or rather upon sections of those exotic minerals, with a view to ascertain their origin by close examination of their microscopical structure. The evidence thus far appears to be strong in favour of the conclusion that they are formed by the aggregation of smaller fragments, or minute particles, in which particular they are most nearly resembled, among terrestrial rocks, by consolidated volcanic ashes. Is there anything in this fact of aggregation which touches the nebular hypothesis?

Action of Magenta on Vegetable Tissues.—Mr. J. G. Lynde describes a series of experiments on cuttings of vallisneria immersed in a solution of that dye in glass cells. He finds that, so long as vital action continues, the cell walls and moving chlorophyle retain their green colour, but the injured cells are immediately deeply reddened, and their contents gradually acquire the same colour. Between the cell walls there exists an intercellular membrane of low vitality, which becomes rapidly coloured while the rotation is going on. He further observed what he believed to be traces of cilia, which, when rotation ceased, left irregular markings, either corrugated, or having raised excrescences, which had the appearance which would be produced by cilia falling against the cell wall in various positions upon the suspension of vital action. The chlorophyle vessels appear to resist the action of the magenta for some time after rotation has ceased, indicating a vitality to a certain extent, at least, independent of that of the cell.

New One-twentieth Objective.—Messrs. Smith & Beck have produced a new $\frac{1}{20}$th objective-glass, which is well spoken of. The definition is described as excellent, and the facility of working equal to that of a low power. The improvements which have recently taken place in optical instruments have thus rendered the use of such a glass not only possible, but desirable, although but a few years back glasses of a much lower power were liable to very considerable working objections. In the present case, a large angle of aperture, combined with flatness of field and perfect correction, render the $\frac{1}{20}$th a lens which will do good service.

New One-twenty-fifth Objective.—Messrs. Powell & Lealand have succeeded in making a $\frac{1}{25}$-inch object-glass, magnifying 7,500 diameters, and thus enlarging a given area fifty-six million times; but we are unable at present to say anything concerning the working of this optical marvel.

Cheap French Microscope.—M. Chevallier has announced, through the Imperial Academy of Sciences, that he has constructed a compound microscope of 250 magnifying power, which he can supply at the moderate sum of sixty to seventy francs (50s. to 60s.).

MINERALOGY, METALLURGY, AND MINING.

MINERALOGY.

Petroleum.—Letters from Upper Canada state that an oil-well which some time since ceased to flow has again commenced spouting, and now yields from 300 to 400 barrels a-day. A large quantity of oil is also being taken from the different wells by pumping, and the inhabitants of the district are about to sink a "test-well" of 1,000 feet in depth, to ascertain what quantity may be expected to flow from a greater depth than that yet reached. Dr. Sterry Hunt says it would appear that the Devonian sandstones of Pennsylvania and North-Eastern Ohio are filled with oil, which has risen from the limestone beneath; while over a great portion of Western Canada this limestone was ages ago denuded, and has lost the greater part of its petroleum. Mr. Schorlemmer has analyzed the oil, and finds that the chemical constitution of that portion of it which boils below 120° C. is quite analogous to that of the oil obtained from cannel-tar. The rock-oils of other countries appear to possess a somewhat similar constitution.

The Alais Meteorite.—Professor Roscoe has examined a fragment of this stone, which fell near Alais, in France, in March, 1806. Berzelius, who examined it in 1834, stated that it contained an organic carbon compound, which turned brown on heating, deposited a black carbonaceous mass, and burnt without residue. In 1860 Wöhler discovered traces of a hydro-carbon in two other meteorites from Hungary and South Africa respectively. These facts are remarkable, since in terrestrial matter carbon compounds are solely the results of vital action. Professor Roscoe found that the Alais stone contains at least a half per cent. of a hydro-carbon, which is deposited in crystals when the mass is treated with ether, together with more than one per cent. of free sulphur.

Castor, a mineral discovered by Breithaupt, in Elba, is a silicate of lithia and alumina. It has been lately re-examined by M. Des Cloizeaux, who finds that it must be considered as a variety of petalite, as conjectured by G. Rose, and that it crystallizes in the oblique system. He also finds that castor closely resembles triphane in crystalline form, whilst it differs from that mineral in cleavage, specific gravity, optical properties, and chemical composition.

Astrophyllite.—A mineral hitherto scarcely known has been recently described by Pisani. It is a variety of mica, found in the laminated felspar of a Norwegian syenite at Brevig. It occurs in six-sided tabular crystals, often grouped into stars. Cleavage, basal. It is transparent in thin sheets. Colour, bronze-yellow; streak, golden yellow. Hardness, about 3; specific gravity, 3·324. Before the blowpipe it melts easily with intumescence to a black magnetic enamel. Heated with carbonate of soda and nitre it gives a strong reaction of manganese. The spectroscope distinguishes lime, soda, potash, and lithia. Hydrochloric acid attacks it, with deposition of silica. It differs from most micas in containing very little alumina and much manganese and iron.

Jade.—M. A. Damour has analyzed the mineral known as white or Oriental jade, which is brought from Eastern Asia, fashioned into ornaments. He considers it as an Amphibole of the species Tremolite. Still more recently he has examined specimens of what is called green jade, a mineral made known by the French expedition to China. It is of an apple-green colour, clouded with darker shades often very like emerald. He finds that it differs materially from white jade, being heavier and harder. It also differs in chemical composition, according to which Damour would place it near to the species of Wernerite called Dipyre. He did not succeed in isolating the colouring matter, which he presumed arose from oxide of nickel. He remarks that this mineral must not be confounded with certain jades of a sombre green, pear-green, or olive, which also come from Asia in a worked condition, and which are merely coloured varieties of white jade. For the Werneritic jade he proposes the name jadeite, to distinguish it from the amphibolic jades.

Samarskite is a remarkable mineral found in the Ilmen Mountains, near Miask in the Ural, and also in North Carolina. It contains a large amount of niobic acid and of peroxide of uranium. The analysis of it is attended with considerable difficulty; but Professor H. Rose now shows that to the two former bodies we must add zirconia and thorina as important constituents of the mineral.

Chilian Minerals.—Mr. D. Forbes has communicated some researches on the composition of several minerals of Chili. 1. *A hydrous arseniate of nickel and cobalt*, apparently a new species, occurs in veins in a greenstone rock of the Desert of Atacama. It appears to have been derived from chloanthite, which occurs beneath it. It is found in fibrous masses. Analysis shows its composition to be a bibasic arseniate of nickel and cobalt, with eight atoms of water. It is remarkable from its being colourless, although containing so much of these two metals. 2. *Bismuthic Silver*, a mineral consisting entirely of silver and bismuth, and therefore differing from Dana's so-called bismuthic silver, which is a mixture of various sulphides. 3. *Sulphide of Lead* and *Zinc*, a mineral occurring in large lumps or nodules. It mostly resembles galena, but is lighter and has less lustre than the latter. It may be considered as a compound of two atoms of sulphide of lead to three of sulphide of zinc. 4 *Taltalite*, a new mineral, has since 1858 been found in immense quantities in the mines near Taltal, in the Desert of Atacama, constituting an important ore of copper. It is of a black or brownish-black colour, and occurs in fibrous masses. It is a silicate of copper, united with a silicate of alumina and iron. 5. *Hayesine —Borate of Lime.*—Mr. Forbes believes that his discovery of this mineral and of its mode of formation places beyond a doubt the fact that the compounds of boracic acid occurring so abundantly in Chili and Peru are due to exhalations from volcanoes. It is found in suspension in the waters of hot springs, which derive their boracic acid from volcanic vapours—the acid acts upon the carbonate of lime contained in the water, forming hayesine, the carbonate acid escaping.

Cavities in Topaz, Beryl, and Diamond.—In an interesting paper contained in the Transactions of the Royal Society of Edinburgh, Sir David Brewster describes some remarkable phenomena which he has observed

in specimens of each of these minerals. Many years ago he discovered cavities in various minerals, some of which contained two fluids, supposed to be hydro-carbons, whilst in others there were crystals of various forms. In examining minerals by polarized light he has more recently discovered "pressure cavities," the optical properties of which show that the containing mineral while in a soft state has been compressed by an elastic force proceeding from the cavity. He considers that the existence and arrangement of these cavities completes the evidence for the igneous origin of the minerals, and of the rocks which contain them.

Lepidolite.—Several varieties of European lepidolite have furnished the new metals rubidium and cæsium. Mr. O. D. Allen, of Yale College, U.S., examined specimens of the same mineral from Hebron in Maine, and found the new element in comparative abundance. Lepidolite there occurs in large quantity in a coarsely crystalline granite, associated with tourmaline and albite. Like the lepidolite of Penig, in Saxony, it is also associated with the rare species, amblygonite. The Hebron lepidolite contains more than three-tenths per cent. of cæsium.

Conversion of Arragonite into Marble.—By heating arragonite in an iron crucible made as air-tight as possible, and by heating lithographic stone or chalk in a porcelain vessel with a ground stopper, G. Rose and Dr. Siemens have succeeded in producing marble. That prepared from arragonite was especially distinct, and closely resembled Carrara marble. Arragonite, chalk, lithographic stone, and marble, are all varieties of carbonate of lime; when heated in open vessels they lose carbonic acid, and furnish quicklime.

Sulphur in Corfu.—A communication from the Board of Trade states that sulphur has been discovered on the Island of Corfu, and that Professor Ansted has expressed his opinion that the vein is of considerable extent and value. The Newcastle Chamber of Commerce is seeking for further information regarding it.

Minerals of California.—The total value of the gold obtained from all the California mines in 1862 was 42,539,799 dollars. The production of mercury in the State has attained an enormous extent. Last year the amount was 3,025,875 lb.; most of which was exported.

Minerals of Australia.—The "South Australian Register" informs us that Mr. Hargraves has carefully examined Western Australia from King George's Sound to Perth, and has found copper, tin, and silver, but no gold.

Calamine in Tipperary.—Mr. George Darlington has described a remarkable deposit of calamine (carbonate of zinc) at silver mines in Tipperary, which has been found within the last four years. The result of exploration has shown an extensive deposit of this ore, varying from ten to sixty feet thick, and covering a known area of several acres. The deposit seems to occur between two stratified rocks; and it yields an ore which averages about thirty per cent. of metallic zinc when freed from its accompanying ochre. Probably 100,000 tons of marketable ore have been laid open. It is the only deposit of the kind yet discovered in the United Kingdom.

METALLURGY.

Plumbago Crucibles are made of graphite, mixed with a certain amount of clay to render it plastic. Some that are now manufactured are capable of melting on an average forty pourings of the most difficult metals, and a still greater number of those of an ordinary character. They are unaffected by change of temperature, seldom crack, and are very durable. Crucibles of this kind are now adapted for malleable iron melting, and for zinc melting.

Examination of Cast Iron.—When melted pig-iron is tapped into a ladle in moderate quantities, and allowed to stand a few minutes until it becomes perfectly quiet, and then carefully skimmed clean, a beautiful iridescence covers its entire surface, due to the constant breaking up of the extremely thin film of oxide formed on the iron. On close inspection, the coating is found to consist of a multitude of many-rayed stars in constant motion, breaking up and re-forming with great rapidity. It has lately been suggested that, as the size of the different figures is believed to depend on the size of the grain of iron when in the pig, the nature of the former will give an indication of the quality of the iron ; and if instantaneous photographs were taken, they might possibly throw light on the phenomena of the crystallization of iron on cooling and the laws regulating it, about which we require much more information than we possess.

Iron reduced by Peat.—Mr. T. Vincent Lee, C.E., gives some particulars regarding this new application of peat. He took specimens of iron so reduced to the Dublin Exhibition, and it was declared by many of the best judges to be equal to Swedish. The quantity of properly prepared peat per ton of iron is about 1 ton, 15 cwt., the cost being slightly in favour of coal or coke; but the price of the iron made by peat is from £2 to £3 per ton above that from coke or coal. Prepared peat will also, he says, generate and maintain steam quicker and better than either coal or coke ; and machinery is now being made in London to produce it.

Action of Wolfram on Cast Iron.—M. le Guen has made experiments on this subject at the military post of Brest, and finds that cast iron composed of old and new iron, combined in the proportions for giving greatest strength, is made much stronger by the addition of less than 2 per cent. of wolfram. In one case, after two fusions, the resistance to fracture was increased by more than a third. The superiority was maintained after several fusions ; and the cast iron so treated was also rendered tougher and more elastic. The wolfram is easily added, merely requiring to be pulverized without previous reduction.

The Action of Manganese in Iron Smelting.—Captain Caron, in continuing his researches on steel, has applied himself to the effects of manganese in iron ore. He remarks that nearly all good samples of steel come from ores containing much manganese, and it has long been observed that its presence is almost indispensable for the production of superior steel. The results of his experiments he sums up thus :—By the addition of a suitable quantity of metallic manganese sulphur is removed even without refining ; silicon is in great part removed on refining ; whilst phosphorus resists its action altogether. These observations are confirmed by experi-

ence. Ores giving the best steel never contain phosphorus, whilst they often have sulphur; and although the ores may contain copper pyrites, the derived cast iron is found free from sulphur. Manganese has also the property of making steel better in quality and more durable. A small quantity of manganese is sufficient to retain the carbon in combination, and thus to give steel of good quality. Yet steel should not contain more than a half per cent. of manganese; above this amount it is rendered hard and brittle, losing much of its tenacity. Many forge-masters use, in refining, a mixture of ordinary and manganiferous cast iron. In this case it is of great importance so to reduce the manganiferous ores, that the iron shall contain the largest possible amount of manganese, in order that the maximum effect may be produced in purifying the ordinary iron.

The Desulphuration of Iron.—Professor Richter, of Leoben, Austria, has studied various means of depriving iron of sulphur. One of the best methods hitherto in use is the addition of binoxide of manganese; but it is objected that being infusible it cannot be thoroughly incorporated with the iron; in addition to which commercial oxide of manganese often contains impurities which may be communicated to the iron. Taking into consideration the powerful oxidizing action of litharge (protoxide of lead), he has endeavoured to apply it for the purpose. He finds that it will not only remove sulphur in the puddling process, but it also oxidizes the phosphorus contained in the iron. The experiments were made near Wolfsberg, in Carinthia, with 7 cwt. of pig-iron containing so much sulphur that it was impossible to convert it into bar. To this was added 3 lb. of sulphide of iron and ½ lb. of phosphide of iron. After complete fusion 3 lb. of litharge was introduced, and the fusion continued. The success was complete; the puddled bar proved neither hot nor cold short, and could be forged into iron for scythes; whilst a similar quantity of cast iron puddled without litharge crumbled to pieces under the hammer. Richter adds that in some instances metallic lead may perhaps be preferable to litharge.

The Spectroscope in Steel Casting.—Professor Roscoe, in a paper on the spectrum produced by the flame evolved in the manufacture of cast steel by the Bessemer process, states that during a certain phase of its existence the flame exhibits a complicated but most characteristic spectrum, including the sodium, lithium, and potassium lines. He expresses his belief that this first practical application of the spectrum analysis will prove of the highest importance in the manufacture of cast steel by the Bessemer process.

Applications of Steel.—Experiments have been made in Prussia to ascertain the capabilities and advantages of cast-steel steam-boilers. Two cylindrical egg-end boilers, one of steel, the other of wrought iron, were compared, and after working six months were examined. They were 30 feet long and 4 feet in diameter; the steel boiler-plate was ¼ inch thick. It was tried by the hydraulic test to a pressure of 195 lb. per square inch without altering in shape or showing leakage. After working six months the cast-steel plates were found quite unaffected, and had a remarkably small amount of incrustation as compared with the other boiler. The former generated 25 per cent. more steam than the latter. Another exami-

nation has recently been made, the boilers having been in use for a year and a half. The steel boiler was found in excellent condition. It appeared that it evaporated 11·66 cubic feet per hour, against 9·37 by the common boiler, with about the same expenditure of fuel.——Steel drills for shaft sinking are taking the place of the old iron drills steeled.——Stamp heads for crushing ore have hitherto been made of cast iron, the fragments of which mixed with and contaminated the ore, often causing great trouble. A trial is now being made of steel stamp heads, doubtless with considerable advantage.

Aluminium.—Messrs. Mappin Brothers are exhibiting various articles in aluminium and its alloys. The main portions of the articles are usually formed of the aluminium-bronze, and a good effect is produced by relieving this with ornaments of "oxidized" aluminium whitened by the addition of a small amount of nickel. C. Fissier, director of the aluminium works at Rouen, shows that one per cent. of aluminium in copper makes the latter more fusible, giving it the property of filling the mould at casting. The copper gains in hardness and tenacity without losing its malleability. In transverse strength this alloy was found to be more than twice as rigid as either brass or copper. An alloy of one part of aluminium to a bronze of 96 copper and 4 tin has a fine colour and is very homogeneous. It does not oxidize in casting, and its transverse strength is two and a half times that of the original bronze, and after hammering four times the latter. At a recent meeting at the Royal Institution, Messrs. Johnson & Matthey exhibited an alloy of aluminium and nickel, containing one and a half per cent. of the latter, which has been tried by hydraulic pressure to 476 lb. to the square inch.

Zinc.—M. E. Gatellier, in endeavouring to account for the great loss of zinc in the smelting of its ores, finds that much is due to the porosity of the retorts in which the operation is carried out, and he succeeded in materially reducing the loss by applying a glaze to the exterior of the retorts by means of common salt—the same material that is employed in glazing in potteries. As a secondary advantage, he points out the less injury to the neighbourhood of the works from saving the zinc, which would otherwise escape into the atmosphere. Mr. George Darlington describes the preparation of zinc-white (oxide of zinc) direct from the ore, as it is now practised in America, where the make is from 8,000 to 10,000 tons annually. The furnaces are similar to coke ovens, with flues leading to collecting rooms and chambers of subsidence. The principle adopted is to evolve the zinc in the metallic state by the action of the fuel (anthracite) upon the ore; as it rises in vapour it finds oxygen at a very high temperature, and is thus converted into oxide. Zinc-white is now in great request as a pigment, as a substitute for white lead, over which it has many advantages.

Platinum.—At a scientific meeting held at Bonn, in the beginning of April, M. von Dechen produced two fragments of crucibles in which platinum had been fused with coke by Dr. Carl Bischof. There was evidence of its perfect fusion, and of the great ductility secured. The crucibles were made of clay occurring in the coal-measures of Waldenburg, in Silesia, discovered by Dr. Bischof in his researches on fireproof clays.

Platinum cannot be fused in graphite crucibles, as the carbon unites with the metal, making it very brittle. Messrs. Johnson & Matthey have prepared specimens of autogenous soldering in platinum, with tubes of the same, having cast iron and leaden screw joints for use with sulphuric acid at high temperatures.

MINING.

Blasting.—The Italian Minister of Public Works has reported on the progress of the Mont Cenis tunnel. Boring machines are now used at each end, worked by compressed air. In 1862, to pierce 380 metres on the side of Bardonnèche, 45,751 holes were bored, from 75 to 80 centimetres (30 to 32 inches) in depth; 72,538 borers were set to work; there were 54,875 blasts, and 1,334,000 cubic metres of compressed air were consumed, equal to 8,004,000 cubic metres of atmospheric air. It is expected that at the present rate the tunnel will be completed in 12½ years.——In consequence of the many accidents from ordinary blasting, the far safer plan of blasting by electricity is gradually commending itself to the mining public. It has long been used in military mining with success, and also in civil engineering, where large masses of rock had to be moved, since several charges may be fired at precisely the same moment. Thus, a few months ago, a large martello tower which guarded the entrance to Chatham harbour was demolished. The charges of powder were each 40 lb., distributed at equal distances beneath the foundations; the whole being connected by wires. In this kind of blasting a pair of wires, united at the extremities by a very fine one of platinum, is placed in the interior of the charge of powder. A current of electricity is passed by a magneto-electric machine. The wires may be of any length, and thus the workman may place himself out of danger. Moreover, if the charge miss fire there is no possibility of any smouldering spark, as in the case of the ordinary fuse, which has led to many accidents from this cause.

Ventilation.—It may be remembered that at the time of the late accident at Risca, the ventilating power was a machine. Immediately afterwards a larger machine was erected; mechanical ventilation being still preferred to that produced by the furnace. Lately, the machine got out of order, and a furnace has been erected to supersede it. English mine engineers, as a rule, consider furnace ventilation preferable to mechanical, whilst the majority of continental miners hold the opposite opinion. Mr. Rogers, of Farnley Wood Colliery, near Leeds, has adopted for ventilating power the heat of coke ovens, which may be placed either at the bottom of the upcast shaft, or at the surface. The system is said to work admirably; and at the same time coal slack, unsaleable at 1s. per ton, is converted into good coke worth 5s. per ton.

Testing Air in Mines.—Mr. W. Keene, the Government examiner of coal fields in New South Wales, has invented a simple apparatus for estimating the salubrity of the air in mines. It is a closed tin box with a glass window in one of its sides, and containing a candle holder. A candle is lighted and inserted, after which the box is closed. It is then seen how long the candle burns; the length of time being proportional to the amount of oxygen in the air examined. Thus, in a particular case, with a vessel

holding a cubic foot, the candle burnt 6 minutes. In a coal mine, where the air is vitiated, it would not burn so long; and Mr. Keene proposes to prohibit working in places where the candle will burn not more than three minutes.

Safety of the Davy Lamp.—At a late meeting of the North of England Mine Engineers, the President, N. Wood, Esq., stated that at a particular colliery, the workmen always made the gauze of their lamps red hot before using them, in order to expel the oil contained in the wire. Rough experiments had been made, and it was found that new gauze was sometimes capable of passing the flame of gas in consequence of the oil it contained, and which is used in the manufacture of the wire. This may account for explosions which have taken place under mysterious circumstances, and when the lamps have appeared in good condition. Whenever a lamp shows any indication of explosive gas, it should be instantly withdrawn; if this precaution is attended to, the Davy may still be considered a safe lamp. Further experiments are to be made.

PHOTOGRAPHY.

THE principal novelty in the way of photographic materials which we are called upon to notice, is the so-called "enamel paper," intended to be used in printing as a substitute for that prepared with albumen. The new article appears to have been originally manufactured in Germany, but already there are several kinds known in commerce;—all of them are, however distinguished for their fineness of texture and the extreme lustre of their surfaces—peculiarities attributable to the employment of mineral pigments, conjointly with albumen, in their preparation. With regard to their exact nature many statements have been made, and the white pigment has been shown to consist sometimes of sulphate of baryta, and in other samples of oxide of zinc, with albumen in all cases as the adhesive material, and a soluble chloride to furnish the necessary elements for the production of the photographic image. The paper is rather thick, and requires to be manipulated in the same manner as the common albumenized material, with the additional precautions of allowing a somewhat longer interval for the final washing of the prints, and taking care not to crease or fold the enamelled surface, which is somewhat sensitive to incautious handling. Varieties of this enamelled paper may be procured in several tints of colour; among others, pale lilac or rose-pink, serving in the representation of subjects where a degree of warmth of tone is appropriate. This description of paper appears generally suitable for *cartes de visite*, stereoscopic pictures, and others of diminutive size; but the excessive brilliancy of the enamelled surface is, for larger subjects, eminently distasteful.

A suggestion relative to the employment of ammonia for the purpose of "fuming" the sensitized surface of papers used in the printing processes has not yet been entirely disposed of; some authorities adhering to the opinion that such treatment confers great advantages on the score of rapidity of action, as well as in the toning process and subsequent mani-

pulation. The difficulty in securing uniform results, and the inconvenience arising from the diffusion of ammonia gas into the atmosphere of the operating-room are, on the other hand, manifest disadvantages.

The double sulphate of iron and ammonia has taken a permanent position in the list of chemical salts required in photography. As a developing agent this solution answers admirably, whilst it is less prone to oxidation than the simple sulphate. The formula of this compound salt, $FeO, SO_3, NH_4\ O, SO_3 + 6\ HO$, indicates a higher atomic value than the crystallized sulphate of iron, $FeO, SO_3 + 7\ HO$, and a proportionately larger amount by weight must be employed in consequence. For its preparation, two parts of sulphate of iron and one of sulphate of ammonia may be dissolved together in four or five parts of hot distilled water; on cooling, the double salt will crystallize out, and the supernatant liquid may be again used for the solution of further quantities of the individual salts. The crystals, drained and dried on blotting-paper, are still liable to be affected by exposure to air, but in stoppered bottles, and with ordinary precautions, they may be preserved for a long time unchanged. The aqueous solution soon acquires a pale brownish tint, which does not, however, appreciably affect its properties as a reducing agent. When required for the development of collodion negatives, the following formula may be adopted :—

Sulphate of iron and ammonia . .	25 grains
Acetic acid	15 minims
Alcohol.	quant. suff.
Water	1 ounce.

The addition of alcohol is merely for the purpose of causing the liquid to flow evenly over the plate; the quantity usually sufficient would be about thirty minims.

M. Meynier's proposal in reference to the employment of the sulphocyanide of ammonium as a fixing agent, has been favourably reported upon by a committee consisting of MM. Périer, Bayard, Girard, and Davanne, and by others in this country; but the encouragement of low cost is yet wanting as a stimulus to further experiment and more general application.

The composition of photographic prints, as regards their metallic constituents, is still under discussion. Dr. Schnauss maintains that in a properly fixed and toned print, there should not be any silver remaining, but that the whole of this metal is ordinarily dissolved out, and replaced by gold in the successive operations of toning and fixing the proof. MM. Girard and Davanne, Dr. Van Monckhoven, and Mr. Spiller, assert on the contrary that this substitution is not completely effected, and that under all circumstances a fair proportion of silver remains in the proof, and may easily be detected, by chemical analysis, in the ashes left on burning the paper.

Mr. H. Cooper gives the following instructions for the preparation of a kind of gelatino-resinous paper, suitable for printing purposes:—Dissolve sheet india-rubber or gutta-percha in chloroform, and add to it benzole in such proportion as will make a solution of three grains to the ounce;

immerse the bottle in hot water and agitate occasionally until completely dissolved. When cool, the solution is poured into a flat dish, and sheets of paper immersed therein, and after a few minutes removed, drained, and dried; they are then salted by floating upon a solution of chloride of sodium (ten grains to the ounce of water), to which a small quantity of Iceland moss has been added. In order to sensitize this paper, it is treated in the usual manner with a 60-grain solution of nitrate of silver.

The recovery of gold and silver from the waste solutions and products of a photographic laboratory has been proved by Mr. England to furnish very lucrative results; many pounds' weight of an alloy of these precious metals having been recovered from the various residues obtained in the printing operations carried on at his establishment. The paper read by that gentleman at a meeting of the London Photographic Society, on the 5th May, details the steps to be taken in order to effect this saving.

The partial eclipse of the sun visible on the 17th May last, and the total eclipse of the moon on the night of the 1st June, were events which do not appear to have claimed from photographers the amount of attention which such interesting occurrences undoubtedly deserve. Among the records of the solar eclipse which have come under our notice are those of Mr. W. Deane, taken at Richmond, and a series of five larger representations which were photographed at Woolwich by Mr. Spiller. The appearance at the moment of maximum obscuration is well shown in the latter series, whilst Mr. Deane's picture shows likewise a peculiar kind of solar radiation, which assumes somewhat the figure of a cross.

The remarkable photographic observations made by Mr. Glaisher during his last balloon ascent excited a great deal of attention; the principal fact may thus be stated: At an altitude of three miles, with the thermometer registering 21 degrees Fahrenheit, and in the clear atmosphere above the clouds, it was found that sheets of sensitized photographic paper were less affected in colour during thirty minutes' exposure than were similar papers held in the sunlight at about the same time, but for one minute only, within the grounds of the Royal Observatory, Greenwich. Many opinions have been offered by way of accounting for these curious results; and it seems generally admitted that the dry condition of the air would naturally induce a state of inactivity in consequence of the removal from the paper of water, which is so necessary in all these cases for the purpose of aiding chemical decomposition, upon which the darkening in colour depends. In apparent contradiction to these results are the former observations of Professor C. Piazzi Smyth, who states that during his ascent of the mountain in Teneriffe he remarked a gradual increase of chemical activity just in proportion as he gained in altitude; and that in using the camera near the summit he found that the exposure might be very much curtailed. To settle this apparent discrepancy Mr. Negretti recently made an ascent from Sydenham in Mr. Coxwell's mammoth balloon, taking with him a camera and all the materials requisite for carrying on the practice of the collodion process; the car itself being fitted up as an operating-room. He likewise found that the time of exposure at great altitudes might be very much shortened. It thus appears that *in the camera*, as in all cases where it is impossible for the water to evaporate from the film or other

prepared surface, there is no indication of the activity of the chemical rays suffering any diminution, but, on the contrary, at these altitudes they are not so liable to b affected or absorbed by transmission through dense air and other media. A further illustration of this fact may be gathered from the statements published many years ago by Mr. Crookes, to the effect that the prismatic spectrum was of greater length and purity, and that the more refrangible solar rays were better defined optically, and endowed with greater photographic activity, at noon on a fine Midsummer day than at any other season of the year; this result being the necessary consequence of their more perpendicular passage at this time through the earth's atmosphere. If now the experimental observations of Mr. Glaisher be considered in connection with the well-known fact that photographic papers lose much of their sensitiveness when deprived, by the action of heat or desiccating substances, of the greater part of their hygroscopic moisture, the interesting announcement of that gentleman may be regarded as furnishing from external nature a confirmatory illustration of this truth, and not be evidence of a notable diminution in the chemical activity of the sun's rays at these great altitudes.

PHYSICS.

DR. W. A. MILLER has been examining the spectrum of thallium, under the influence of a progressively-increasing temperature. It is well known that when thallium is examined in the ordinary way it exhibits in the spectroscope only a single green line of intense brightness. Dr. Miller found that on employing the flame of burning hydrogen, and then of the oxyhydrogen jet, as the temperature increased the brilliancy of the green line also increased, but no new lines made their appearance; but on employing two stout thallium wires as the electrodes of a strong induction coil, by which means a still higher degree of heat was obtained, several new lines which were proved to belong to the metal appeared. In addition to the intense green line, the spectrum contains several very characteristic groups of lines, somewhat similar to those of the spectra of cadmium and zinc, and in a less degree like that of lead.

MM. P. Christofle and F. Beilstein have been examining the spectrum of phosphorus and the coloration of the hydrogen flame by phosphorus and its compounds. A very small quantity of phosphorous acid communicates a beautiful green colour to the hydrogen flame. On examining by means of a spectroscope the flame of hydrogen into which either this substance, phosphorus, or hypo-phosphorous acid was introduced, two beautiful green lines, and a third a little less vivid, appeared. From the extreme sensibility of this method, and the exact results obtained, it is evident that the process may be used for detecting phosphorus in cases of poisoning.

Mr. Gassiot exhibited, at a recent soirée of the Royal Society, a very powerful spectroscope, with nine glass prisms. It showed the yellow sodium line double, the two portions appearing about a quarter of an inch asunder.

Kirchoff has published in the "Philosophical Magazine" for April "Some Contributions toward the History of Spectrum Analysis," in which he reviews the parts taken by various investigators in the development of this subject. In the same number is a short note by Dr. Roscoe, "On the Spectrum produced by the Flame evolved in the Manufacture of Cast Steel by the Bessemer Process." The author expresses his belief that this first practical application of spectrum analysis will prove of the highest importance in the manufacture of cast steel by this method.

Dr. Joule also describes a new and extremely sensitive thermometer. He states that it is able to detect the heat radiated by the moon. The instrument consists of a vertical glass tube, two feet long and four inches wide, closed at the bottom end, and divided longitudinally by a blackened pasteboard diaphragm, leaving a space at each end about an inch in length. A magnetized sewing-needle is suspended over the edge of the division at the top. The slightest excess of temperature of one side over that of the other occasions a circulation of the air up one side and down the other, which in doing so moves the index.

Mr. G. Gore, of Birmingham, has produced a new and simple furnace capable of smelting cast-iron, copper, gold, &c., without the aid of a bellows or lofty chimney. Its heat is generated by ordinary coal-gas and atmospheric air; its consumption of gas is from 30 to 40 cubic feet per hour; "it has smelted five ounces of copper in four and a quarter minutes, and is capable of fusing half a pound of copper or six ounces of cast-iron;" its size is about that of a Stilton cheese; and it possesses the valuable qualification of continuous access to the contents of the crucible for any length of time without oxidizing it or materially lowering its temperature; the crucible may also be removed or a fresh one introduced without interfering with the action of the furnace.

Some additional experiments "On the Motion of Vapours towards the Cold" is given by C. Tomlinson in the May number of the "Philosophical Magazine." They consist of a few of the subsidiary facts observed during his previous inquiry, which we have already noticed in a previous number of this REVIEW.

Mr. W. R. Grove, F.R.S., has recently delivered a lecture to the Chemical Society, "On the Action of Heat upon certain Fluids." His observations had reference more particularly to the bumping action observed whilst boiling water which has been deprived of its dissolved air. We know that if water has been deprived of air by means of an air-pump, or by means of long-continued boiling in a vessel with a very narrow mouth to exclude the atmosphere, the application of heat is not attended by constant and regular ebullition as when water is boiled in a wide open vessel, but the water is for a short time quiescent, and then suddenly at intervals evolves explosive bursts of steam; and a thermometer immersed in the water shows a variable temperature, hottest just before an explosion and least hot immediately after. A consequence is that no one has yet been able to observe the true boiling-point of water.

The lecturer found that on boiling ordinary water, air containing a slightly increased proportion of oxygen was first driven out; the proportion of oxygen then gradually diminished until pure nitrogen was expelled.

But he had not succeeded, even on boiling nineteen out of twenty parts of the water away, in expelling the whole of the nitrogen. Water that has been so boiled rapidly absorbs air again. His general conclusions were, that water has a very powerful affinity for the gases of the atmosphere, and especially for nitrogen; that by several processes the oxygen may be removed from water, but the nitrogen resists all efforts at separation, and therefore it is doubtful if absolutely pure water had ever been prepared; and that ebullition in water consisted in the production and disengagement of bubbles of steam formed upon a nucleus of a permanent gas.

Several letters to and fro, between Dr. Tyndall on the one hand and Professors Thomson and Tait on the other, respecting the manner in which Dr. Tyndall has treated the claims of Dr. Joule of this country in the subjects of heat, &c., *versus* those of Dr. Mayer on the Continent, have been published in recent numbers of the "Philosophical Magazine," and reach their climax in the number for June, in which Dr. Thomson declines to take part personally in any controversy with Dr. Tyndall.

Dr. Matthieson and Dr. Vogt have examined the influence of temperature on the electric conducting power of thallium, and find that thallium decreases in conducting power about 31½ per cent. between the freezing and boiling points of water.

The Rev. N. Callan describes in the June number of the "Philosophical Magazine" "an induction coil of great power." With this coil he has obtained electric sparks "fifteen inches" in length. This, if we recollect rightly, is less than that obtained by Mr. Siemens with his large induction coil exhibited at one of the soirées of the Royal Society, and described in a previous number of this Review. The length of wire in the secondary circuit of Dr. Callan's coil was "150,000 feet."

Mr. W. Ellis has published in the "Philosophical Magazine" for May an account of some experiments he has been making "on the change of rate produced in a clock by a particular case of magnetic action." He describes the different conditions under which the clock was retarded or accelerated by the influence of approximated magnets.

A paper by Dr. Angus Smith has been read before the Royal Society, "On the Absorption of Gases by Charcoal." He has found that charcoal absorbs oxygen so as to separate it from common air, or from its mixture with hydrogen or nitrogen at common temperatures, and that it absorbs it for at least a month, rapidly at first and slowly afterwards. It does not absorb hydrogen, nitrogen, or carbonic acid for the same period. Water expels mercury from the pores of charcoal by an instantaneous action.

Mr. Hunter, of Queen's College, Belfast, has also been experimenting in the same subject. He finds that logwood charcoal absorbs the most ammonia, fustic charcoal most carbonic acid, and ebony charcoal most cyanogen.

ZOOLOGY.

Species of Rhinoceros.—Mr. Blyth has been at great pains to examine into the statement of Helfer, that the three known species of Asiatic

rhinoceros inhabit the region of Burmah. He succeeded during his travels in that country in confirming the existence of the one-horned *Rhinoceros Sondicus*, and the two horned *Rhinoceros Sumatranus*, but believes that these two insular species are the only ones of the Indo-Chinese region; the third species, *Rhinoceros Indicus*, appears to be peculiar to the region at the foot of the Himalayas, and the province of Assam.

The Moa.—A letter from Mr. E. L. Layard, Secretary to Sir George Grey, Governor of New Zealand, states that two species of this bird have been found to maintain a lingering existence in that region. Of one species of comparatively small size (about 3½ feet high) a specimen has actually been killed and eaten by a party of explorers, and fifteen others seen. Of the other species, one of the large Moas, the fresh footsteps, fifteen inches long, have been traced, as Mr. Layard states, by a party who had lost themselves. Both these living species inhabit the little explored Middle Island, never thickly peopled, and nearly depopulated about thirty years since. It is suggested that although tradition points to the recent existence of the Moa, and there are no large animals capable of having exterminated it, the prevalence of bush fires may have had that effect. The probability, however, is that it still exists in some of the untrodden tracts of the Middle Island.

Pulsations of the Heart in Quadrupeds.—In a recent lecture at the Royal Institution Professor Marshall stated that by an ingeniously contrived apparatus, he found the pulsations to increase in frequency as the size of the animal diminishes. Thus in the horse they number 55 per minute; in man 72, in the dog 96, in the rabbit 220, and in the squirrel 300. But whatever the size, the number of beats required to complete the circulation throughout the whole body averages 27; and the proportion of the weight of the blood to that of the whole body is 1 to 12.

Tooth-billed Pigeon.—This bird (*Didemculus strigirostris*), of so great interest as being believed to be the nearest ally of the Dodo, has been discovered to be not quite extinct, as was believed. Mr. Williams, Consul for the Navigator Islands, after several years of unsuccessful efforts, has managed to procure a single living example. A person who visited the Navigator Islands in November last ascertained that, although the bird is now totally extinct at Upolu, a few are still to be found on the island of Sawaii, the largest and most mountainous of the group, and exertions are being made to secure a specimen for the gardens of the Zoological Society.

Struggle for Life.—The Royal Commissioners for inquiring into the operation of the laws relating to the herring fisheries, state that the take of herrings by fishermen within the jurisdiction of the Scotch Fishery Board amounted in 1861 to nearly 900 millions. It is very common to find a codfish with six or seven herrings undigested in his stomach. If we allow a cod only two herrings a-day, and estimate that he feeds on herrings for only seven months in the year, he takes 420 as his allowance during that time; and since at least 2,400,000 codfish were caught in 1861, and the cod and ling caught were certainly not a tithe of those left behind, the destruction of herrings by them alone may be estimated at ten times as great as that effected by all the fishermen put together. The Commis-

sioners add: "A plentiful supply of herrings in any year nourishes an increased army of enemies; and if these latter multiply too fast, the herrings become diminished in number, whereupon the fish that destroy them are starved down, and in a weakened state more easily fall a prey to their own enemies. The herring, then, relieved from their oppressors, in a year or two appear again in immense numbers, and so the alternations of prosperity and panic in the trade which they originate will occur with as much regularity as if the herrings were manufacturers."

Frogs v. *Fishes.*—The Imperial Court of Montpellier have just decided on an appeal in which the point in dispute was whether a *frog* is a *fish*. The judgment was affirmative; and those persons who have hitherto thought that they might catch frogs at all seasons in private or public waters now find that they were mistaken.

Sun-Birds and Humming-Birds.—Mr. Wallace, who has had ample opportunities of observing these birds in a state of nature, and has carefully examined into their relationship, declares that no true affinity exists between the sun-birds (*Nectarinidæ*) and the *humming-birds* (*Trochilidæ*). The sun-birds are a specialized form of an extensive group of typical perchers (*Passeres*). The latter are essentially of the character of *swifts*, profoundly modified for an aërial and flower-frequenting existence, but still bearing in many important peculiarities of structure unmistakeable evidence of a common ancestry. Hitherto these families of birds have been considered as bound together by the closest family relationship, the sun-birds sucking the nectar of flowers by means of a tubular retractile tongue.

New Insect Pest in London.—Mr. E. Newman calls attention to a new insect infesting the Friends' Institute in Bishopsgate-street. He observes that there are two well known to every one—viz., the cockroach and the cricket; but this is a novelty, to which he has given the name of *Lepismodes inquilinus*. It is half an inch long in the body, and the antennæ and tail are also each half an inch in length, so that the whole length of the insect is an inch and a half. It is nocturnal in its habits, and chiefly infests the dining-room, but is frequently caught, from the fact that its feet being non-prehensile it slides down the smooth sides of saucers and basins, &c., and is unable to escape again.

Neuter Ants.—M. Charles Lespés has obtained some singular results from an investigation into the rudimentary reproductive system of neuter ants. He finds that ants do not seek aphides indiscriminately, but that each species seems to have its particular favourites; and in the same manner, those which bring up the larvæ of coleopterous insects, for example, *Claviger*, select certain species for their attentions. He also finds that all neuters have the rudiments of ovaries, developed in a very different manner in different species; and that many have two forms of neuters which sometimes pass insensibly into each other, and are sometimes divided by sharp lines of distinction, forming data for classification.

Aquatic Hymenopterous Insects.—A second species of these remarkable insects has been found by Mr. Lubbock, and named *Walkeria aquatica*. It swims, not by means of its wings, as *Polynema natans*, but holds its wings motionless under water, and uses its legs only, though these are

neither flattened nor covered with setæ. Respiration appears to take place in the usual way through spiracles. Although 50,000 species of Hymenoptera are known, of which 3,500 live in Britain, until this time no aquatic species was known.

The British Museum.—Professor Owen complains in his annual report of the want of space which causes choice rarities to be added perforce to the vaults intended for storage. The whole number of additional specimens is 28,273.

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